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FOREST SERVICES OF MEMBER COUNTRIES

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Cover Photograph: *There are several centers in Iraq which, because of their favorable topographic situation, high precipitation and numerous springs, are important for poplar cultivation. Shaqlawa, shown here, has been recommended as a site for a new poplar nursery. The photo was taken from the regional forestry office by E. Allegri of the Italian Forest Service in the course of an FAO mission to advise on poplar cultivation* (*See "Work of FAO"*).

FOREST RESOURCES AND POPULATION

SOME one thousand specialists from all over the world gathered at FAO headquarters in Rome last September to attend a World Population Conference sponsored by the United Nations and its specialized agencies. One of the many topics given consideration was the adequacy of the world's forests, as a natural renewable resource, for a world population that might reach 3,600 million by 1980.

The inventory of forest resources, recently concluded by FAO and reported in the last issue of *Unasylva*, showed that only two-thirds of the world's accessible forests were now in use as sources of timber and other forest products. There appeared to be a reserve of around 640 million hectares of forest accessible but not yet exploited, and a second reserve of 2,140 million hectares of forest not yet accessible — that is a total of some 2.78 thousand million hectares. On this evidence, there would appear to be ample forest resources to provide over the long term for the requirements of a far greater world population than to-day's, even assuming an average yearly wood consumption much in excess of the present three-fifths of a cubic meter of industrial and fuel wood per head.

But these figures of forest still in reserve need to be interpreted with circumspection. Around half of the total must be regarded as fulfilling primarily a protective role and is not to be brought into full reckoning as a potential source of raw material. The remaining 1,400 million hectares also include considerable areas in northerly climates or on poor soils where productivity must be relatively low. Some areas, too, must inevitably be converted to agriculture.

Again, wood is heavy and bulky and often uneconomic to transport over long distances, so that timber from the Amazon cannot readily be regarded as available to satisfy, for example, the needs of the Far East. Indeed, wood is scarce and expensive in the relatively nearby highlands of South America despite the vast areas of untouched forest in the Amazon.

Moreover, the large number of forest tree species that exist, especially in the tropics, have a great diversity of chemical and physical properties which offer an additional difficulty to the full use of undeveloped forests. Lack of knowledge as to useful qualities or possible manufacturing processes, often bars from economic exploitation forest resources otherwise physically accessible.

Nevertheless, since population can clearly not be kept down to present levels of production of wood, or of any other commodity for that matter, production must be brought up to the level of population. So forestry and industry have great and various tasks ahead to match useful output of wood and all other products derived from wood to real needs. We know how this can be done. But it is essential to remember that, in this context, *we* happen to be those who possess the knowledge and capital and mostly live in those parts of the world already highly advanced. It is in the areas of the more undeveloped forests or of practically no forests at all where the greatest increases in population are likely to occur in the course of the next few generations.

Above. *Part of the exhibition unit. Villagers looking into the model box and listening to a recorded commentary.*
Below. *What they saw — a forbidding semidesert scene showing the dire effects of indiscriminate destruction of trees.*

Forestry and Fundamental Education

An Experiment in Mysore, India

by John Bowers
Director of UNESCO Group Training Scheme for Fundamental Education

This is an account of an experimental marriage between education and forestry.

But let us begin at the beginning of the story. The General Conference of UNESCO at its Seventh Session in 1952 resolved that "in order to meet the acute shortage of specialists... a group training scheme to train future experts in fundamental education be organized in one of UNESCO's Associated Projects."

The term "fundamental education" has been defined by UNESCO as:

> "that kind of education which aims to help children and adults who do not have the advantages of formal education, to understand the problems of their immediate environment and their rights and duties as citizens and individuals, and to participate more effectively in the economic and social progress of their community."

It may be well described as the educational arm of social and economic development and is specially concerned with those areas of the world where formal education is not available to all and where a high degree of illiteracy is found, generally in conjunction with widespread poverty and disease — namely the so-called underdeveloped areas.

There has been in the secretariat of UNESCO for the past seven years a division charged to help Member Governments to "extend and improve fundamental education in their territories." Many projects and activities have been studied in every continent and in many countries — some operating under the name of "fundamental education," others under different names, such as "community education," "mass education" and "social education." Experts have been sent to assist them — on an increasing scale since the development of the United Nations Expanded Program of Technical Assistance. Yet this experience has revealed that fundamental education is still in a pioneer stage, that much practical research is needed and that staff must be trained if this new and vital use of educational techniques is to be developed to its full potential.

In agriculture, for example, and in forestry, every country has its long-established research institutes, its experimental farms and plantations, its trained specialists in varied fields, such as soil science or pestology, its training colleges and its university departments. The techniques of growing food and trees have been constantly studied and improved. Yet the techniques of grafting new knowledge and new skill upon the old stocks of ignorance and illiteracy are still in a rudimentary stage.

To meet this situation UNESCO has established, or helped governments to establish, a number of rural Fundamental Education Centers in which practical research, the training of specialist staff and the production of prototype educational materials are co-ordinated in a single program. FAO has co-operated, and continues to co-operate, with UNESCO in a number of these projects. But educational specialists are needed to staff these centers, and the scheme which is the subject of this article was set up, at the invitation of the Government of India and the Government of Mysore State, to train them.

The area chosen for the scheme is a typically underdeveloped area. It is a dry area with an average annual rainfall of about 20 inches (500 millimeters) lying to the northwest of Mysore City. Perhaps because of its climate it is one of the depressed areas in a State which is noted for its progressive development policies. The headquarters of the UNESCO scheme is a 18th century house, known as the "Yelwal Bungalow," 10 miles from Mysore City; and within a 5-mile radius, in an undulating landscape of barren and gravelly soil, lie more than 70 villages. It is an ideal training area, presenting as it does so many of the problems that fundamental education must inevitably face: a high rate of illiteracy; a heavy density of population; land hunger and fragmentation; shortage of grazing land in an area where religious tradition forbids the killing of cattle; erosion and increasing barrenness of the soil; few productive crafts and widespread poverty in the population. Due perhaps to the dryness and coolness of the climate at 2,500-3,000 feet (760-900 meters) above the sea, and the efficiency of the health services, disease is not a serious problem, in spite of a complete absence of sanitation and sewage disposal in the villages. Malaria is controlled and the occasional epidemics of cholera or plague are usually held in check.

This then is the area in which UNESCO is carrying out the resolution of its General Conference "to train future experts in fundamental education."

From December 1953 to July 1954, 17 persons from 10 countries of Europe and Asia went through a practical course of training, and a second course, involving 15 persons from seven countries of Asia and Australasia, is continuing from September 1954 to May 1955.

To quote from the final report on the first course [1]

[1] *Final Report on the First Course* (GTS/FE/Re. 9): November 1953-July 1954, pp. 29. Mimeographed. Available in limited quantity from the Director, UNESCO Group Training Scheme for Fundamental Education, Yelwal Bungalow, Mysore (India).

"Probably the most valuable feature of the course was its experimental nature. It was itself an experiment in training. Equally it imparted training by experimental methods... we could and did learn as much from failure as from success... and it is no false humility to add that the staff certainly learnt as much as the students."

But the reader may well enquire at this point: "What has this scheme of educational training to do with forestry?" The answer is: "A great deal"; for this scheme, limited as it was in time and scope, indicated the possibility of a very fertile union between forestry and fundamental education.

Forestry as a Subject for Educational Experiments

In the jargon of fundamental education and community development much is made of the principle of the 'felt need.' The purists of this school of thought state with some justice that people will not take effective action on projects that are thrust upon them by interested outsiders, unless they, the people, appreciate the need for these projects and see clearly that they are going to reap some tangible benefit from the efforts they put into them. This is certainly a sound principle, but it may lead, if it is slavishly followed in conservative and inert communities, to prolonged inaction.

In the Mysore Training Scheme we adopted a flexible attitude to this matter, and conceded to the 'felt need' school that fundamental education and development work in a community should certainly begin, whenever possible, by helping the people to attain the immediate objectives that they consider most important, especially if this enables them to gain confidence and to practise co-operation in helping themselves. On the other hand, we considered that it might also be an important function of fundamental education to call attention to the real needs of the community that were not fully appreciated — or perhaps not appreciated at all — by the people.

It was partly to test the validity of this attitude that we turned our attention to forestry.

The Progress Report of February — the third month of the Mysore Training Scheme — contains the following record, under the heading: "Selection of Topics."

"Looking beyond the boundaries of the Government forest plantation which surrounds the bungalow we could see vast stretches of barren hill-tops, covered with lantana scrub and dried-up grass. Below them patches of poor gravelly soil and, here and there, scraggy trees, lopped of their branches by the villagers in search of fuel or of fodder for their goats. The problem of deforestation and erosion was obviously a serious one in this area.

We recalled also that, in our visits to Government Departments in Bangalore during December, the Chief Conservator of Forests, Mr. M. A. Muthanna and his staff had taken a genuine interest in our project, had spoken with feeling on the menace of deforestation and had promised us co-operation if we decided to work on this subject.

But our first concern was to find out whether the villagers themselves were aware of the problem and how far they understood the complicated relationship between trees and climate and the fertility of their soil. A number of our group, therefore, discussed this with the villagers and found that some few individuals were concerned about it. Obviously reforestation was not, in the current jargon, a felt need of the area. We recognized that the difficulties of persuading villagers to tackle this problem were enormous, yet it was argued that one of the functions of... fundamental education was to transform 'real needs' into 'felt needs.'

So we paid another visit to the Chief Conservator of Forests, obtained more information on the problems of the Yelwal area and a promise that he and Dr. M. N. Ramaswamy, his Research Officer, would visit the Yelwal Bungalow and discuss these problems with the whole group.

In this way we committed ourselves to the topic of tree-planting as the first target of our experimental educational activities."

Study of the problem in the villages

This procedure was not as systematic as we should have liked. Had we been working in a long-term development project, we should certainly have preferred to have deployed in advance our social sciences team which was studying the application of anthropology and experimental psychology to fundamental education, before taking our decision. We should have liked to have waited for the results of two sample village surveys, in order to discover, for example, why deforestation was taking place, and how rapidly, what were the conflicting claims in the limited land space, how far food growing, grazing and tree planting were in competition, and much other relevant data on the subject. In particular, we should have liked to have set our psychology unit to undertake an 'attitude study' to discover, more systematically than we could by our random questioning, what villagers thought about trees and tree planting, about deforestation and erosion, and the interaction of trees and climate and soil fertility.

In the time at our disposal we could not do this, but as the village surveys of our social sciences team progressed we did gather an increasing wealth of information on the whole subject. We learned, for example, that fifty years ago the whole of our training area had been richly forested, and now timber for houses must generally be bought for three rupees a cart-load at the cost of a six-day visit to a forest area 30 miles away, that the 100 acres (40 hectares) or so of barren hill-top that dominated one of our pilot villages, with its meager covering of stunted bushes and sparse yellow grass and its eroded gulleys, provided grazing ground for 12 surrounding villages and an unknown number of stunted and mostly useless cattle. We learned that a chemical fertilizer factory was buying 1,000 tons of wood fuel a year from the few remaining stands of timber in our area; that a prosperous gentleman in the neighborhood was encouraging the villagers to cut down their remaining trees and sell them to him as middleman fuel merchant.

THE TRENCH-MOUND METHOD OF PLANTING TREE SEEDS

Above. *Planting the seeds. Mixed seeds are sown on the top of the mounds and in the trenches.*

Top right. *Young trees in their first year.*

Below right. *Young trees in their third year in the Forest Department's plantation.*

We watched also the wasteful methods of the village carpenter, chopping away with his primitive adze. We compared the fine, straight, carved pillars of the older houses with the miserable, twisted, cracked, unseasoned poles that supported the poorer houses of more recent date. We found that timber for building the better styles of village houses and for cart making, once available locally, now had to be imported from forests 30 to 40 miles (48-64 kilometers) away. We found an increasing number of women making dung cakes for burning, as the supply of wood fuel decreased or disappeared. We listened to the complaints of the village potters and their wives that they had to walk miles to fetch the fuel for their ovens.

We watched the small boys with knives bound to long poles lopping the branches of the ficus and neem trees for their voracious goats. We saw many ancient groves of ficus and mango falling into decay. We saw trees being cut down and burnt down, but hardly ever a young tree planted within the past ten years.

Another interesting thing we discovered was that we should not use the word 'forestry,' either in our discussions with villagers or with local officials. This term, rightly or wrongly, was associated in their minds with large-scale timber cultivation in national forests, and implied to them the exclusion of all other uses of land from the area. So we banned the word 'forestry' from our vocabulary, and adopted the term 'tree planting and protection' to describe the process which we aimed to encourage through educational activities in our training area.

Technical Co-operation with the Forestry Department

Our social sciences team investigated methods of studying and analyzing the community. (It is a generally accepted principle that a basic survey should precede any important education or development project, in order to provide data for planning and a base line for the subsequent evaluation of progress.) But we found, as, of course, we expected, that such a survey demands the co-operation of specialists in other fields relevant to social and economic development. And since tree-planting had become one of our most immediate interests we naturally turned first to the Forestry Department of Mysore.

The February Progress Report records how we obtained the generous co-operation of the Chief Conservator of Mysore and a promise that he would visit our center.

> "In preparation of this visit, and in order to extend our knowledge of this complicated subject, we drafted a questionnaire[2]... This was sent to the Chief Conservator of Forests and also to the Forestry Division of FAO, with a request for information on tree-planting in dry areas in other parts of the world. The FAO took an immediate interest in the project and promised some useful documentation." (This was later received from several parts of the world.)

[2] *Questions on Reforestation in the Yelwal Area* (GTS/FE/QU 4). Mimeographed. pp. 5.

"The visit of the Chief Conservator of Forests and Dr. Ramaswamy was a most stimulating experience for our group. After two hours of discussion based upon the questionnaire we took our visitors out to a typical area of barren land, two miles (3 kilometers) from the bungalow, and obtained further practical advice on how such an area could be dealt with by the local population, if their energy and interest could be aroused."

This exercise enabled our group to learn how specialists in fundamental education must draw upon the knowledge of specialists in other technical fields, which are beyond their competence but are nevertheless the essential substance and content of the educational program.

Experimental Media

At this stage we were planning to produce some experimental audio-visual materials (films, filmstrips, recordings for radio broadcasts, posters etc.), on our selected topic and the audio-visual team which contained the group's photographers, film makers, graphic artists and radio specialist, was now drawn into the scheme. The Progress Report for March records this development:

"Following the decision taken in February that a village tree-planting campaign should be the focus of our production activities, the audio-visual team, accompanied by a member of the social sciences team, made a trip to Bangalore in the first week of the month to study the subject more deeply and to obtain photographs in color and black and white for filmstrips. The team had further discussions with the Chief Conservator of Forests and his Research Officer, visited the Forestry Research Institute, and spent a large part of the two-day visit taking photographs in the government plantations some ten miles (16 kilometers) outside the city.

Special attention was given to the trench-mound method of tree planting, which makes it possible to grow many species of trees on barren soil with rainfall of 20 inches (500 millimeters) and less. As its name implies, this consists of digging a series of trenches, about 1½ feet (½ meters) deep, 1½ feet across and 12 feet (3.7 meters) long (following the contours of a slope) and piling the earth from trenches into mounds on the down-hill side of the trenches. Mixed tree seeds are sown on the top of the mounds and in the bottoms of the trenches, which serve to catch and hold the rainfall like a sponge, retaining the moisture long enough after the end of the rainy season to enable the young tree seedlings to establish themselves. This method, which is quite unknown to the villagers of the Yelwal area, is cheaper and easier than the old method of planting individual seedlings in separate pits. The team also obtained detailed information on the various species of trees that should be grown and their uses.

As a result of this visit a document was prepared with the title *Tree-Planting in Dry Areas*".[3]

At this stage, also, the Chief Conservator very generously assigned to our Center as full-time technical advisor, Mr. A. N. Sharman, a field officer of his department.

Film making

It was one of the purposes of our scheme to train a small three-man film unit in making films for villagers. We had strong views about the production of such materials. We had examined a large number of films made in different countries for fundamental education and extension work. We projected some of these to the villagers of our training area, and with co-operation of the psychology department of Mysore University, our psychology unit carried out an evaluation of the villagers' response.[4] The result confirmed our belief that the use of foreign films and films made by city-based units, with scant appreciation of the attitudes, interests and level of comprehension of illiterate adults, have little educational impact on rural audiences. It was our conviction that films for villagers should be made in villages as far as possible with village actors and should be in an idiom that holds the interest of the villagers and is understandable to them, even at some sacrifice of technical quality. Their production is a specialized job, involving the co-operation of film technicians, educators and practical psychologists, with technical specialists in any subject which may be chosen as the topic for a film.

It was agreed that our film unit should start work on a 16 millimeter film in color on a dramatic theme intended to arouse the interest of village audiences in the importance of planting and maintaining trees on their lands. It would be left to filmstrips and other media to instruct them in the methods of tree planting and protection.

So this unit went with the forestry advisor to a village 5 miles (8 kilometers) from our bungalow, in which our social sciences team was undertaking a pilot survey. The village had the unpronounceable name of Dadadakallahalli, but it had two advantages, that it had a large area of barren eroded land suitable for reforestation and that the village headman and elders had expressed interest in planting trees.

We hoped to get the villagers to carry out a tree planting campaign and to enact for us the dramatic story which we had built into a script, and on which they had already expressed favorable views. We have no space here to describe the many problems and vicissitudes which attended this experiment — for example, the difficulty of getting villagers, and especially village women, to act naturally before the camera, or the general inertia of the villagers themselves when it comes to putting their good intentions into practice.

One of the worst problems, which inevitably faces any attempt to persuade cultivators to plant trees, arises from the fact that tree planting has to be done during the rainy season when everyone is occupied from dawn till dusk in their millet fields. Suffice it to say that, with constant encouragement, we persuaded the villagers to turn out in full force for one day and

[3] *Tree-Planting in Dry Areas* (GTS/FE/5). Mimeographed. pp. 6.

[4] *Report of Audience Reaction Evaluation Project.* (GTS/FE/9). Mimeographed. pp. 14.

to plant 150 seedlings along the approach road to their village, — thereby providing some good crowd scenes for our film. All our efforts of peaceful persuasion, however, failed to induce them to try out the trench-mound method on their waste lands. And then at the crucial point our leading actor left the village on a long journey.

Since by this time our second experimental film was going ahead rapidly, we decided to give up the struggle in Dadadakallahalli and to concentrate the attention of the film unit on the completion of the other, a horticultural film: " A Garden Comes to Life " and here our problems were much less acute. The owner of the garden was a natural film star and the garden did come to life before our eyes — an ideal subject for filming in color.

After six months, therefore, we have to record that our attempt to make a dramatic motivational film on tree planting has not yet succeeded. We shall persevere during the second course, which is now beginning in the Yelwal Bungalow. Nevertheless, as a training exercise the experiment was most valuable, revealing as it did, in contrast to our other film on horticulture, the worst problems of making films for villagers, in villages and with village actors, and the great difficulty of arousing enthusiasm for an unfelt need — the planting of trees.

Filmstrips and exhibition unit

It is widely accepted that, while the motion picture is an excellent medium for arousing interest and enthusiasm, the filmstrip — modern counterpart of the magic lantern slide — is generally a more suitable, and certainly a much cheaper, medium for instructional purposes. Acting on this assumption we completed two filmstrips, one in color and one in black and white, showing the trench-mound method of tree planting in dry areas.

But of all the projects undertaken by our audio-visual team perhaps the most interesting was the construction of an experimental exhibition unit on tree planting.

In this project we used a training technique which proved useful in other aspects of our course. In February, we prepared a first draft manual entitled *How to set up an Educational Museum-Exhibition Unit.* This recorded, somewhat imaginatively, our plans for the exhibit, which we then tried to put into practice over the next five months.

Our artists worked with tremendous energy, drawing posters and diagrams, constructing various gadgets, and trying out all manner of locally available substances, such as crepe rubber, papier maché, clay, gauze and putty, for constructing models. A local carpenter was employed; and the glass blowers of the Food Technological Research Institute in Mysore helped us to make a sectional working model of a tree, which drew water up from the subsoil through its roots and emitted it as vapor into the air. A glass cloud incorporated in the same model then produced a realistic rainstorm.

We were convinced that, for illiterate audiences, a much increased impact would be achieved if our models and other visual elements could be equipped with sound, so that they had a simultaneous appeal to eye and ear. Our radio specialist therefore worked with a model constructor and together they produced a ' viewing box ' with earphones linked to our tape recorder. The effect of this gadget was spectacular. The viewer looked through a small window and saw a brilliantly lit diorama model of a typical landscape with figures of a man cutting a tree and boys lopping branches for goats. Then he passed to another window through which he saw the dire results of the indiscriminate destruction of trees — the same landscape 50 years later — a forbidding semidesert scene, with a few decayed trees, skinny cattle seeking grass in a dried up pond, all illuminated by a lurid sunset sky at the back of the box. And, as the viewer looked, a voice (our tape recorder) spoke softly into his ear in simple Canarese language:

> " Fifty years ago your land was rich, green and shady. Trees grew around your village and fields. These trees provided your fathers with fuel and timber, and enriched their soil with humus formed from the falling leaves.
>
> Now you are looking at the same land as it is today. You are chopping down your trees and lopping off the branches to feed your goats. Yet you never replant the trees when you cut them down. So your land gets more barren and your crops yield less each year. You are destroying the trees which bring moisture to the air and protect the land from the heat of the sun and damaging forces of rain and wind. You are depriving your land of the rich humus that comes from their leaves.
>
> Now move to the next window, and you will see what your land will look like if you continue to destroy your trees. Later we will show you how you can prevent this devastation of your land. "

We also included in the exhibit three stereo-viewers, showing a series of color slides made by our photographer to illustrate methods of tree planting. The special attraction exerted by this item encouraged us to believe that ' 3D ' photography has a great future for fundamental education.

A series of magnifiers of varied power then introduced the villagers to the strange process of magnification and to the beauties of germinating tree seeds. These were accompanied by diagrams explaining to the viewers what they saw.

The exhibition was finally set up in the central hall of the bungalow for our farewell function on 19 July. The response which it evoked from our visitors, including some five hundred villagers from our training area, was most gratifying to those who had worked long and hard on its construction.

At this stage, we produced a revised second draft of our Manual,[5] and illustrated it with diagrams and photographs of the actual exhibit. Our concern in the next course, if funds can be found for the purpose, is to construct a fully mobile exhibition-unit, which can move from village to village on a specially constructed

[5] *How to Construct an Educational Museum-Exhibition Unit* (GTS/FE/20). Mimeographed. pp. 17.

bullock cart. This will involve further experiments with cheaper and less complicated sound installations. Finally, we plan to produce a third, final, and more authentic, draft of our *Manual on Exhibition Units* for fundamental education.

Radio

Our radio-student also took tree planting and protection as his central topic. Programs for six rural broadcasts were prepared. These included a number of talks and an opera composed by Sri K. A. Karanth, the well-known Canarese writer, dramatizing the problem of deforestation in villages.

Our broadcasts were recorded on our own tape recorder and were played in villages, and again to an appreciative audience at our farewell function. Their effect on village audiences will be tested more systematically during the second course.

Radio is not yet developed in our area as a medium of rural education and extension work, but experiment with our own recording equipment gave us training in how this subject could be handled in any area where receivers were effectively installed and maintained to pick up rural broadcasts.

Adult Literacy

A team of six persons in our group was specializing in adult literacy work. We started from the conviction that literacy is not an end in itself nor necessarily an essential prerequisite of fundamental education, but that, whenever adult literacy is an accepted policy, it should be efficient and effective. The world is littered with the debris of literacy campaigns which have failed. Large sums are spent in many countries on teaching illiterate adults by out-of-date and academic methods to the point where they can read a set passage and gain a literacy certificate, but not to the stage of what is sometimes called 'functional literacy.' So it was the purpose of our scheme to train a group of future specialists in rational and up-to-date methods of teaching adults to read and write, in training teachers and in setting up classes. This involved them in the production of a whole series of new primers and teaching materials in the Canarese language, and the testing of these materials in three experimental classes. It was always our view that literacy teaching should be integrated with other aspects of fundamental education and community development, so we brought forestry into our production program.

Two important principles, among many others, guided the production of our teaching primers:

1. they should be attractive and interesting to adults;
2. they should not try to teach new ideas or complicated subjects at the same time as they taught the basic skill of reading and writing.

We did not attempt, therefore, to teach tree planting. The story, written for our primers by Sri K. S. Karanth, and the illustrations done for us by a famous Indian artist, Sri K. K. Hebbar, had a religious motive which is always attractive to Indian villagers, but through it all ran the idea that a land without trees is a poor land. Indeed at the climax of the story a mendicant Yogi gives a handful of seeds to the headman of the poor village, with the words:

"This is the blessing, go and plant these";

and as he leaves the barren village he promises:

"After the trees have grown and the shade has come, I will come back."

And so ten years later at the end of the second book, the Yogi returns to find the once barren village pleasantly shaded with trees, and the fields and gardens fertile and well tilled.

Later in our second course we may turn to the production of so-called follow-up reading materials in simple language on the relationship of trees to climate and soil fertility, or the trench-mound method of planting.

Training of Field Workers

Since it may often be a function of the fundamental education specialist to train field workers and teachers and to produce simple manuals for their guidance, we made a study of this activity and, as part of our study, produced a draft manual, *Tree Planting in Dry Areas*,[6] for village-level workers (the Indian term).

This draft was submitted to FAO and is already being revised with a view to laying more emphasis on the difficulty and importance of protecting young trees from grazing goats and cattle. Its purpose is to suggest in very simple language how the village teacher or extension worker can set about persuading villagers to plant and protect trees. In imaginary dialogues it raises the objections that villagers will raise, and the answers that can be given to them. It incorporates in practical terms the advice given to us by the Forestry Division. It describes how trees may be planted on waste lands by the trench-mound method without excluding the grazing of cattle. It indicates what species can be planted on cultivation boundaries and how they can be used by composting to enrich the soil. It indicates in simple terms the vital influence of trees on climate and water supply, and gives a list of species suitable for the area with notes on their uses, and the right way to plant them.

Like all our materials it is the product of a training scheme and not, therefore, to be measured by the standards of production applicable to an established fundamental education center. Nevertheless, we think that, with some further revision, it may have the makings of a useful booklet for field workers in this area.

Conclusion

Perhaps the experimental marriage which was arranged between fundamental education and forestry cannot yet be acclaimed an established success in that we have not yet achieved — or attempted — a widespread tree-planting campaign or made a noticeable impact on the age-old conservatism and inertia of the villagers. But in two respects we feel that it has been of intense value: first as a training exercise, and secondly as a pilot experiment.

Let us briefly consider these two aspects of the scheme.

[6] *Manual for Village-level Workers in Fundamental Education: Tree Planting in Dry Areas* (GTS/FE/18). Mimeographed. pp. 14.

Sixteen young people from ten countries of Europe and Asia have benefited from this experiment. All of them are potential experts in fundamental education; four of them have already taken up responsible junior positions in UNESCO's fundamental education projects and centers in Cambodia, Thailand and Bolivia. One has returned to work in the Burmese Mass Education Movement; six more are being absorbed into education and development work in India.

They have learnt much of the very complex relationship between trees, climate and the fertility of the soil. They have become aware of the menace of deforestation and erosion. They have learnt in some detail how they, as specialists in the production of educational books, broadcasts, films and other visual aids, or as literacy workers, social scientists and psychologists, can work with specialists in other technical fields to produce educational materials on different subjects. Above all they have learnt, by an intensive, if inconclusive, experiment, how fundamental education can and should be integrated into a wider rural program, not as an end in itself, but as the educational arm of community development. They have learnt how their services as specialists in fundamental education could be devoted to a long-term program of enlightened forest policy in areas where large-scale, commercial or national forestry is not an economic proposition.

It is, however, as a pilot experiment that our scheme may perhaps be of most interest to FAO and to readers of this review.

Our scheme was a short-term project for training specialists in educational techniques, but in the nine months of our first course, we were able to get a fair idea of how a more permanent fundamental education center could carry out the three functions of research into educational methods, the production of educational materials and the training of specialists and extension workers to use them, and of how these services could be placed at the disposal of a rural development program — involving also a forest policy to encourage people to plant and protect trees.

In areas where ignorance and economic pressure have caused the indiscriminate destruction of trees, a forest policy must win popular support if it is to lead to widespread and effective action. We believe that this demands intensive fundamental education, bringing to bear systematically all available media of mass communication and propaganda. On the basis of our pilot experiment we think that a fundamental education center could produce these materials in the course of one year, with advice from an imaginative forestry specialist. They should be produced for a single climatic and cultural region. But this is not to say that they might not be exported to other areas and other countries and there adapted and used with good effect. We still believe, however, that imported materials are a poor substitute for materials custom-tailored to the local needs.

We suggest that a fundamental education center should undertake the production of such materials — involving also, as it must, testing, and the evaluation of audience response and comprehension, as part of the production process. (Consumer research is just as important in selling ideas as in selling shoes or saucepans or cigarettes.) We constantly stressed in our course that the educator must not exceed his competence and pretend to be an agriculturalist or a forestry expert. Equally, we felt, the agriculturalist or forester should not pretend to be an education specialist. The production of posters or educational filmstrips or books and pamphlets for newly literate adults, is just as technical a job as making trees grow on desert land. It should be done by centers properly staffed and equipped for the purpose, not by small propaganda units operating independently in the various technical departments of government.

ESTIMATED COST OF PRODUCTION EQUIPMENT FOR A REGIONAL TREE-CAMPAIGN IN INDIA

Equipment	*Rupees*	*Dollars*
One poster (double color 1,000 copies)	100/–	21.00
One motivational film (2 copies 20 minutes black and white with commentary)	2,500/-	530.00
Three filmstrips (50 copies)	300/–	63.00
Six radio broadcasts (assuming an existing transmission and reception network)	300–/	63.00
A mobile exhibition unit [1] with audio-visual equipment	5,000/– to 15,000/–	1,060.00 to 3,180.00
6 books, pamphlets, and cartoon strip-books for literate adults (250 copies each)	3,000/–	630.00
One training manual for teachers and extension workers (50 copies)	300/–	63.00
TOTAL	Rs. 11,500	$ 2,430.00

[1] This can be built on to a cinema projection van at considerably less cost.

So, assuming a center set up with competent staff and production equipment, let us consider the cost of production for a regional tree-planting campaign on the basis of our experiments in India.

All this assumes that there are in the area teachers, leaders, and other agents of fundamental education, as well as forest officers and extension workers, at the village level, some of them equipped with projectors, who are able, or can quickly be trained, to use these materials. This training would itself be a proper function for a fundamental education center.

It is not, of course, essential that all these instruments of fundamental education should be brought to bear on any single campaign, but, even supposing the highest intensity of propaganda effort, and production costs of Rs. 15,000/- ($ 3,180.00), would not such a project be justified in comparison with the cost of cumulative devastation caused by deforestation, erosion and loss of fertility of soil?

In the small experiment in Mysore we have tried to integrate forestry and fundamental education. If a forestry expert could be introduced into one of UNESCO's established Fundamental Education Centers, a more permanent union might be brought about to show the world what can be done by such a partnership to check the destruction of its vital natural resources.[7]

[7] See also "Forestry for All," *Unasylva*, Vol. VIII. No. 2, 1954.

Fire in Relation to Forest Grazing

by R. S. Campbell

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In many parts of the world, burning, through centuries of use, has become a common practice to aid hunting, to improve grazing and to clear land. Whether caused by lightning or by man, fire has long been associated with several major plant types. As Shanz has said:

> "Much of the earth's surface now in grassland would without fire surely pass to forests, many coniferous forests would pass to hardwoods, and much of the higher and better parts of the Mediterranean type would pass to forest."

In some areas, fire is regarded as undesirable, particularly in forest and watershed management. It is the purpose of this paper[1] to summarize the effects of fire under major climatic and vegetation conditions, and to list the salient points to be considered in the development of policies for controlling fire and using it in the management of forest range.

Temperate Humid Climates

The temperate humid zones include the great areas of coniferous forests in the northern hemisphere and the broadleaved or mixed broadleaved-coniferous forests found to some extent on all continents.

The general trend in many temperate broadleaved forests is toward separation of forest from grazing land, especially in western Europe and northeastern United States: in these areas the question of fire as related to grazing is not serious.

The opposite extreme is offered by the Coastal Plain pine belt of the southeastern United States. In this area, the controlled use of fire has reached a high degree of development for forestry, frequently in conjunction with range grazing and wildfire. This situation will be described in some detail because it illustrates many features applicable elsewhere.

Coastal Plain pine region, southeastern U.S.A.

The soils of the southeastern coastal plain are mostly red and yellow podzolized lateritic types that have developed under the native pine and pine-hardwood forests. It is estimated that 90 percent of the virgin longleaf pine (*Pinus palustris*) forest burns over at least once every three or four years, mostly with surface fires.

The chemical composition of surface soils in the longleaf area seems to be slightly improved by frequent burning. Potash, calcium and other minerals are returned to the soil in readily available form. Repeated fires result in small but significant increases in soil nitrogen. The increase in nitrogen is attributed mainly to the decay of grass roots on burned areas that would otherwise grow up to brush (which has fewer roots than grass).

The physical properties of surface soils in the longleaf area are unfavorably affected by frequent burning, since burned-over soil is up to five times as hard and absorbs water less rapidly than soil on unburned areas. The organic debris and top 2 inches (5 centimeters) of mineral soil on unburned plots contain far more microfauna than similar layers on burned areas.

As to vegetation, annual winter burning of uncontrolled intensity has been found to retard the growth of longleaf pine saplings by about one-fifth in diameter and one-fourth in height. Longleaf seedling survival during a 10-year period was 43 percent on unburned ungrazed plots, and less than 5 percent on annually-burned plots. However, scrubby hardwoods encroached on unburned areas, while annual burning controlled this growth. On unburned tracts the brush and accumulated dead vegetation and pine needles smothered the herbs and grasses, while on areas burned annually, bluestem grasses (*Andropogon* spp.) and native legumes grew abundantly.

Wildfires, and even controlled annual burning, are obviously too damaging to the forest growth and the site. However, the trend under complete fire exclusion is toward a mixed pine-hardwood-brush association considered undesirable by foresters, range managers, and wildlife managers alike. Some degree of burning seems desirable in the silviculture of longleaf pine. As a matter of policy, prescribed burning is used primarily for silvicultural purposes and only secondarily to improve grazing.

Specific purposes for which fire may be used in the long leaf - slash pine forests are listed by Conarro as follows: preparing seedbeds or planting sites for pine, controlling insects and rodents, eliminating plant diseases and unwanted brush, reducing the fuel that wildfires might feed on, improving grazing, and maintaining favorable conditions for naval stores operations. Harper reports that burning the vegetative cover of the soil by surface fire increased the gum yields of longleaf pines about 4 percent during the succeeding year, while fires that killed needles decreased yield as much as 19 percent. Controlled or prescribed burning is also used to provide food and cover for upland game. Bickford and Curry have worked out detailed instructions for

[1] Originally prepared as a working paper for the FAO Technical Meeting on Forest Grazing at Rome, Italy, 29 March to 3 April, 1954. See *Unasylva*, Vol VIII, No. 2, p. 81.

analyzing the need for using fire, and for treating individual burning units.

On ranges where the grasses become dry and innutritious when mature, burning may be used to remove the old growth so that cattle can graze on succulent green grass high in nutrients. In the bluestem type of Mississippi, Louisiana, and east Texas, frequent burning may not be necessary if grazing is close enough to prevent accumulation of excessive grass "rough". In the wiregrass (*Aristida* spp.) type of the southeastern United States prescribed burning about every third year appears essential if the range is to be grazed effectively.

In spring and early summer cattle spend most of their grazing time on freshly burned areas if any are available. Rates of stocking during early seasons should, therefore, be based primarily on the acreage of burned upland. From year to year it is also important to adjust cattle numbers to any reductions in forage that may occur as low density timber stands become more dense.

Mixed hardwood-conifer and fir forests

In many temperate rain forests the relation of fire to forests and grazing is quite different from that described for the southern pine area in the United States. In New Zealand, for example, when fires occur on the margins of the mixed broadleaved-conifer forests, "the scorched trees die and bracken and scrub encroach, creating vulnerable salients from which succeeding fires sweep further in." In North Island, where very steep slopes have been converted to improved pastures, fairly large areas have been overrun by brush, which cannot be controlled by burning. Similarly, in the Douglas fir (*Pseudotsuga menziesii*) region of the northwest United States successive fires result in dense stands of bracken (*Pteridium aguilinum*), creating a vicious cycle that tends to perpetuate the fern patches, and preventing the establishment of either forage plants or a new forest. There are indications, however, that carefully controlled burning may have a place in management of grazed ponderosa pine (*Pinus ponderosa*) forests of the Rocky Mountains. Its function would be to reduce wildfire hazard and possibly to thin dense stands of reproduction.

Temperate Dry Climates

The drier areas, such as the Mediterranean type (sclerophyll brushland) and desert scrub, have important needs for grazing, water, and domestic fuel. Foresters have a direct interest in developing fire policy for such areas.

The Mediterranean type is one of the most widely distributed plant communities, yet is relatively small in total area. Shantz states:

> "Throughout the world, this sclerophyll brushland is regarded by plant geographers as a fire-induced type... The same physiological and ecological requirements are found in this type whether it be in South Europe, North Africa, Asia Minor, Southern Australia, South Africa, Central Chile, or in California."

The winter rains produce a brush cover that becomes very inflammable during the dry summer season. Shantz thinks that broadcast burning is the main reason that a large area of California is now occupied by nearly useless chamise brush (*Adenostoma fasciculatum*). In Greece, repeated brush fires have caused entire loss of the soil on large areas.

Sampson summarized the forestry, grazing, watershed, and wildlife values involved in the California chaparral type. He concluded that haphazard burning should be supplanted by controlled burning restricted essentially to the better chaparral lands, and complemented with management methods that favor succession and stability of the herbaceous vegetation. He recommends:

1. consideration of expected benefits in relation to costs;
2. selecting the specific area to be burned and establishing adequate firebreaks;
3. burning late in the autumn if fire risk is high;
4. an adequate, experienced crew.

Desert scrub

On semi-desert ranges, dense stands of brush often reduce the value of the land for grazing. Pechanec and Stewart pointed out that wildfire in the sagebrush (*Artemisia* spp.) type of the intermountain region, in the western United States is often disastrous to range, livestock, and other property. Areas burned haphazardly may grow up to even denser stands of sagebrush, or the perennial grasses may be replaced by annual cheatgrass brome. However, "increased usability and greater grazing capacity of the range without damage to adjacent property are dependable results of planned burning."

The principal requisites for burning on grazed sagebrush range are that:

1. fires are controlled;
2. soils are firm and slopes less that 30 percent;
3. sagebrush is dense and forms more than one-half the plant cover;
4. fire-resistant perennial grasses and forbs form more than 20 percent of the plant cover (if this condition cannot be met, burns should be made only where reseeding is practicable);
5. grazing can be properly managed after burning.

A further study showed that organic matter, nitrogen, and moisture equivalent are significantly reduced, but only temporarily, in the top half-inch (1.2 centimeters) of soil on heavily burned areas. Planned burning appears to benefit rhizomatous grasses and forbs and shrubs with strong sprouting habit, but severely injures non-sprouting shrubs, suffrutescent forbs, and some of the finer bunchgrasses.

A closely related condition is found in southern Argentina. Here, Davies noted the value of periodic burning with flame throwers to control the shrubby growth, which may make up as much as 88 percent of the Patagonian scrub and desert vegetation. He suggests selective burning to prevent damage to palatable shrubs.

This classification includes the tropical rain forest with abundant rainfall at all seasons as well as the humid tropical forests with dry winters. Many such areas around the world have a long history of burning, especially in connection with shifting cultivation. In fact, the practice of shifting cultivation and the attendant risk of burning and brush fires can easily destroy the tropical forest, particularly on steep slopes or in regions with a long dry season.

For Cambodia, Allouard lists burning for pasturage as a primary cause of fires in tropical forests. He recommends a program of land classification and protection, education, and research to promote forestry and meet the needs of the populace for grazing. A similar problem and program is proposed for forests in Venezuela. Aubréville expresses concern over the disappearance of the high tropical forests of central Africa Since the social progress of the native populations is linked with the development of their agriculture, he suggests restrictions on indiscriminate burning and land clearing. He advocates a long-term program on an international scale to study problems of African soils and forests, to develop new agricultural methods adapted to local needs, and to promote policies of forest protection and management.

A different situation is found in the southern highlands of Tanganyika, where the original rain forest is reported to have given way to open grassland through woodcutting and annual grass-burning over probably two or three centuries. This mountain grassland seems to be an unusually stable type, not easily affected by close grazing or burning. Burning during the dry season, possibly every second year, appears to maintain the tallest, densest grass growth and to suppress unwanted brush and weeds.

The gradual development of policy on controlled burning and grazing in India up to 1925 is described in detail by Stebbing. An early policy of complete protection gradually gave way to a recognition of the possible place of early burning in silviculture, first with teak, and later with chir.

Banerji calls attention to the general fodder scarcity for the huge cattle population of India, with the inescapable overgrazing of many areas, damage to trees through too severe lopping for cattle feed, and the frequent over-use of fire. He reports that the present trend on reserve forests is initial closure to grazing and protection from fire to allow better grasses to reappear, followed by mowing and light grazing, then by rotational and deferred grazing. Controlled burning for grazing apparently has a place on selected areas. Banerji urges research and co-ordination of range management activities through national policy.

Bharucha and White emphasize the importance of grazing and fire in ecological succession and conclude that:

> "the future agricultural development of India depends primarily upon proper integration of new systems of animal husbandry with the development of potential grazing and fodder resources."

Problems of grazing and burning in the tropical dry climates are similar in many phases to those in tropical humid climates. The main areas involved are the tropical savannas, scrub forests, and desert scrub of Africa, Central and South America, southern Asia, and northern Australia. According to Roseveare, burning in South America may be for destruction of old herbage to provide fresh young growth, destruction of woodland and undergrowth to provide grazing or arable land, and destruction of pests and parasites. There are conflicting views on forest range burning and research is needed to assess the facts.

Beard states that all the tropical American savannas may be swept regularly by fires, but that the present vegetation is fire-resistant. He concludes that the herbaceous vegetation does not depend upon fire for its maintenance, and that the savanna is an edaphic climax usually on senile land forms subject to alternate waterlogging and desiccation. McCorkle, speaking of savanna burning in British Guiana, concludes that unrestricted burning should be checked, that occasional burning may have some merit in simplifying grazing use, but that correction will be difficult because the practice is deeply rooted in the life of the native Indians.

In Africa, there is agreement on the general trend toward impoverishment of forest and soil but disagreement as to the causative agent. Aubréville condemns fire for its effects on timber production and living conditions, and for its possible ultimate effect on precipitation. Jeffreys quotes native authorities on the need for and practice of burning, and attributes the degradation of plant cover and soil to exploitative cultivation rather than fire. Semple concludes that:

> "clearly burning of grassland cannot be abolished or condemned as wholly destructive. If practised with discrimination, it can be of great value in supplying livestock with more palatable feed."

He suggests that, where economically feasible, mowing be employed instead of burning.

The beneficial use of fire in tropical grass and grass-shrub types has reached a high degree of development in the veld of South Africa. Scott points out that basic principles of veld management must rest on a knowledge of the ecology of the particular veld type and on the seasonal development of the grasses. Management differs for sweet, mixed, and sour veld types, depending on the species present, their palatability to livestock at various stages of development, the encroachment of undesirable brush, and the response to time and frequency of burning. There is need to extend the principles of veld management to the extensive Bantu areas, but difficulties are shifting cultivation, ownership of livestock as a measure of wealth, communal ownership of land, poor distribution of water, and lack of fencing.

Grazing for Fire Protection

Livestock grazing measurably reduces the fire hazard by removing and breaking up potential fuel and by establishing trails through the forest. For example, Lemon found that moderate cattle grazing removed 44 percent of the herbage on an experimental range in southern Georgia, United States.

Grazing may also be employed for fire protection on fertilized and seeded firebreaks through the forest. Peevy reports that fertilized and seeded areas were grazed closely each year during a four-year experiment in central Louisiana, United States.

In grazing forest range as an aid in fire protection it is important to avoid localized overgrazing, with consequent damage to tree reproduction and soil compaction from trampling. Customary methods used to get even distribution of grazing are fencing, herding, water development, and salting on lightly grazed areas.

Means of obtaining more even distribution of grazing and methods of establishing and maintaining grazed firebreaks are promising fields of research that should lead to better integration of livestock with fire protection and forest management generally.

Conclusions

In most parts of the world, the problem of fire in relation to forest grazing is closely interwoven with other problems of land use and of social and econmico betterment. Climate, plant cover and its reaction to fire, population, resources, livestock numbers, agriculture and social customs are so variable that the fire problem must be attacked country by country and area by area.

All countries and peoples have a common starting point: the haphazard or too frequent use of fire is condemned universally by those who have studied the subject carefully. The weight of evidence under all climatic conditions is that excessive use of fire, especially when accompanied by overgrazing or shifting cultivation, degrades both plant cover and soil. Accompanying ills are reduced productivity of forests and ranges. These detrimental effects, when carried to an extreme in densely populated areas, result in progressively inadequate nutrition of both livestock and humans, and ultimately in rural slums.

In many parts of the world, fire appears to have a definite place in forest and range management. The problem is to eliminate haphazard burning and to apply prescribed, controlled burning where it is needed.

The fire problem must be considered as only one phase of the whole complex effort to improve management and productivity of renewable natural resources. Policy on the use of fire in forest range management involves the:

1. need to curtail fires started in unwise attempt to improve forage conditions;
2. possibility that grazing will aid in protecting forest range against destructive wildfire;
3. use of prescribed burning to improve forage and grazing conditions, consistent with timber values;
4. use of prescribed burning as a tool in silviculture and timber management;
5. integration of fire policy for grazing with policy and administration of other natural resources;

The development and application of a fire policy requires the following measures:

1. Surveys should be made to determine the extent and frequency of burning and the reasons for it.
2. Land use must be planned to set up ti[illegible] and potentialities for arable land, timber p[illegible] ucts, watershed protection, and forage fo[illegible] wildlife and domestic animals. Estimates must be made of the livestock required for work meat, and fiber, and the feed requirements of such animals in the form of range forage, tree loppings, improved pastures, fodder, and feed crops. The land must be classified to meet these needs and possible modifications of agri-social custom and organization should be explored.
3. Research should be undertacken to work out the applied ecology of each broad plant type; the effects of fire on the vegetation and site; conditions under which fire should be excluded; need, time, frequency, and techniques of prescribed burning; and management after burning.
4. Demonstration areas and education should inform the land users of needed improvements in practice.
5. Action programs could be put into operation to protect against wildfire and to regulate the practice of controlled burning in improved land use.

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Crown Prince Vajiralongkorn of Thailand helping to plant a teak tree in the palace grounds. Looking on are Queen Sirikit and Her Royal Highness Princess Ubolratana. The Thai Royal family are greatly interested in forestry and conservation.

Radiata Pine in Chile

by C. W. Scott

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This article is based on a lecture delivered at the University of Concepción. A considerable volume of information on Pinus radiata *was forthcoming from the* 1954 *New Zealand Timber Conference. The writer did not have access to this material but his paper summarizes much useful reference information from many scattered sources.*

The home of *Pinus radiata*, also called *Pinus insignis*, is about 100 miles (160 kilometers) south of San Francisco in Monterey County of California, U.S.A., where it is native to a very small coastal area about 10 miles (16 kilometers) long by 3 miles (5 kilometers) deep. The species is of no appreciable commercial account in North America, but it has become of very great commercial importance in the Southern Hemisphere where over half a million hectares of the pine have been planted. Thus from a small native range of some 30 square miles (7,800 hectares) of Monterey in California have come over 1,700 square miles (440,000 hectares) of densely stocked plantations in the Southern Hemisphere.

Table 1 shows the approximate areas of plantations reported to exist in the countries concerned in the years shown. The only figures available in Chile at the moment relate to different years between 1948 and 1953 but are adequate for a broad picture of the position.

Table 1. – Approximate Extent of Plantations of *Pinus radiata* in the Southern Hemisphere

Country	Area of plantations (Ha.)	Area of plantations (Sq. miles)	Year for which data are available	Remarks
New Zealand	222 000	867	1952-3	About 148,000 hectares of privately-owned and 74,000 hectares of state-owned plantations
Chile	173 000	668	1953	Mainly privately owned, being increased by some 10,000 hectares annually
Australia	40 000	154	1951	Chiefly in the State of South Australia and Government owned
South Africa	12 000	46	1948	Out of some 180,000 (1950) hectares of conifer plantations of all species. Almost all the radiata pine is Government owned
	447 000	1 757		

Growth and weight of wood

Pinus radiata belongs to the botanical sub-genus of the hard and pitch pines or *Diploxylon* (the name refers to the number of vascular bundles in the leaves).

The rate of growth of the tree in South Africa, New Zealand, Australia and Chile appears fairly similar where the soil and rainfall are comparable, being fast to very fast in all four countries. Thus in the South African trees to be described below, which were tested carefully for weight and strength at various points in their boles, the average number of annual rings per inch of stem radius over 30 years was approximately four, to produce a tree of 16.8 inch diameter under bark, at breast height, in 33.5 years. The number of rings per radial inch varied, of course, from 2.2 near the pith to 6.6 near the bark.

Table 2. – Variation in Annual Growth Rings in South African Trees

Age, in years	Annual rings, per radial inch
1 to 5	2.3
6 to 10	2.2
11 to 15	5.0
16 to 20	5.5
21 to 25	5.9
26 to 30	6.6
30 and over	no data shown

The average weight of the adult wood of radiata pine, laid on after about the first 12 years' growth of juvenile or core wood, appears to be often about 33 pounds per cubic foot (529 kilograms per cubic meter) at a moisture content of 15 percent of its oven-dry weight. Usually the first 12 or so annual rings of wood which it lays on around the pith, medulla or dead center of its bole are relatively lighter in weight and lower in strength than the adult wood laid on in annual rings or layers after about the twelfth year of the tree's life. This average weight of 33 pounds per cubic foot (529 kilograms per cubic meter) is a common one for hard pines, including such widely known commercial timbers as the Scots pine or "red deal" of Northern Europe (*P. sylvestris*), the maritime

pine of the Landes of southwest France (*P. pinaster* or *maritima*), and the red pine of eastern North America (*P. resinosa*). It is some 6 pounds per cubic foot (96 kilograms per cubic meter) more than the common weight of the soft or 5-needled pines, which average about 27 pounds per cubic foot (144 kilograms per cubic meter), air dry, and is about 4 to 11 pounds per cubic foot (64 to 176 kilograms per cubic meter) less than the dense resinous pines found in the southeast of the U.S.A. and in the Caribbean, known as southern yellow pine or pitch pine. Further, this common weight of adult air-dry radiata pine wood (33 pounds per cubic foot) is the same as the average weight of the Douglas fir (*Pseudotsuga taxifolia*) exported from North America, other than the selected, dense, slowly grown and very strong lumber from virgin stands of that species.

Strength

Weight at known moisture content, in any given kind of timber, is usually a very good index of the strength in bending and crushing and of the hardness of the timber. Numerous standard strength tests of Monterey pine in South Africa, Australia and New Zealand bear this out. They also show the excellent strength of the adult wood of this species, and the rather surprisingly satisfactory strength of its average wood, cut from logs of only 15 inch (38 centimeters) diameter or less, even when in that case the 2 × 2 inch (5 × 5 centimeters) test pieces or the structural sizes inevitably include a considerable proportion of juvenile wood from near the pith. *Pinus radiata* (as a species) appears to form wood of reasonable strength and general quality even when growing very fast. Table 3 shows the standard strength data determined in the Forest Products Institute, Pretoria, South Africa, and also some comparable strength figures for well-known European and North American conifers imported into South Africa.

Table 3. – Mean Sample Tree Strength Data for *P. radiata*, Grown in South Africa [1]

	Modulus of rupture (static bending)		Maximum crushing strength		Hardness			
					End		Side	
	lb./sq. in.	g./cm²	lb./sq. in.	g./cm²	lb.	kg.	lb.	kg.
P. radiata	12 500	879 000	5 150	362 000	1 100	500	790	358
Scots pine	11 200	787 000	6 360	447 000	740	336	550	249
Douglas fir	11 700	823 000	7 420	522 000	760	345	670	304

NOTE: Average mechanical properties corresponding to the mean tree sampled.
[1] 34 years old, 46.25 cm. in diameter over bark at breast height, at 12 percent moisture content.

The above data show that the relatively young and fast grown radiata pine wood is stronger than the imported wood in bending and hardness but that in crushing strength it is 19 percent less strong than imported Scots pine and 31 percent less strong than the imported Douglas fir. (It is not difficult, of course, to make up for this lower strength by a larger cross-section, at least in properly designed house-building).

It is clear from the work in South Africa and elsewhere that the mere width of the annual rings, or in other words the number of such rings per radial inch, is not alone a good direct index of strength. The weight and strength of South African pine increase radially outwards from the pith towards the bark, and also decrease upwards in the stem, at least for some considerable time. However, as the weaker annual rings near the pith are usually wider than the stronger rings which occur further out towards the bark, these younger and wider rings are usually an indication of lower weight and strength. Their sharper curvature or smaller radius is also an easily seen index of their position in the stem and probable lower weight and strength.

Seasoning or drying

The wood is relatively easy to dry quickly and without distortion, compared with Chilean hardwoods, especially *coigüe*, *roble*, *ulmo* and *tineo*, either in the open air or in a kiln. Shrinkage during drying and stability after drying are relatively moderate and favorable, provided there is no spiral grain or compression wood, and that as far as possible one avoids or does not expect too much of the smaller dimension pieces with very wide juvenile annual rings on one face and less wide and older rings on the other face; because these two types of wood, the juvenile type near the pith and the adult type further away from the pith, shrink differently and tend to cause distortion even with careful handling.

Compression wood is a well-known defect which is found in many softwoods, on the concave side of leaning trees or the underside of branches. It is known in German as *rotholz*. The cell walls of such wood are extremely thick and the wood is very dense. The fibrils of the cell walls are inclined away from the vertical to an abnormal extent and may be nearer horizontal than vertical. As a result, compression wood shrinks abnormally in a longitudinal direction and is apt to cause bad distortion. The corresponding defect in hardwoods is called tension wood, and occurs on the convex side of leaning trees or the upper side of branches, with similar results to the wood.

Grading

There is no difficulty in devising practical grading rules for radiata pine. It has been done in various countries and with marked success in South Africa by the Forest Products Institute. There is great need for special grading rules in Chile, as the existing rules for Chilean timbers in general are not satisfactory for the purpose. Draft rules based on the well-proven grading rules for the somewhat similar southern yellow pine of the U.S.A. (*P. palustris*, *caribaea*, *taeda* and

echinata) have been drawn up by the Corporación Chilena de la Madera (Corma) in collaboration with FAO and are now under trial by a leading producer of radiata pine in Chile.

Knots are the chief item which must be controlled in such rules, as to size, number and kind (tight, loose, etc.). Later in this paper the excellent results of early pruning of side branches in South African practice will be referred to. By such pruning, where the labor for it is available and cheap enough, the proportion of clear wood free of all knots can be greatly increased and the average grade and value of the lumber raised correspondingly.

A still simpler and cheaper way to raise the grade of radiata pine lumber is to dip it in an anti-blue stain bath as it comes from the saw, using penta-chlor-phenol if available, or possibly a 5 percent solution of borax. The latter is better against the stain fungi which attack hardwoods such as *tepa* than for conifers. This matter also will be referred to again later in this paper.

Durability

The heartwood of this timber has appreciable natural durability but the sapwood has none. The sapwood is indeed very susceptible to attack by rotting fungi, especially if in contact with the ground or at a moisture content of over 20 percent. It is also liable to attack by termites and other insects, whether wet or dry. Fortunately, both the sapwood and the heartwood are permeable and very easily treated with preservative oils or salt solutions, which is a most important characteristic. It means that young and fast grown wood of radiata pine, largely sapwood, can be given excellent durability and made suitable for outdoor uses, even in the ground, if it is properly impregnated, through and through or to an adequate depth, by a good preservative which will not leach out. The best method of treatment is in a pressure cylinder; but where that is not possible or is not necessary (because the wood is to be used in a dry climate or relatively little exposed to the wet with consequent danger of decay) very good results can be got by simpler methods, such as open tank soaking, dipping, a diffusion treatment, or even brushing, so long as adequate penetration is secured and the preservative does not leach out subsequently. Brushing is the least effective method and only suitable with specially penetrating preservatives and in special cases, where the risk of decay is not severe. It is not effective with ordinary preservatives for fence posts to be set in the ground.

Use of Radiata Pine

South Africa

South Africa has about the same area of exotic pine plantations as Chile but in 1951 no one species made up more than 26 percent of the total area. The crop was of eight species of pine, including about 26 percent of *Pinus pinaster* (*maritima*), 22 percent of *P. patula* (from Mexico), 14 percent of *P. caribaea*, 12 percent of *P. longifolia* (from the Himalayas), 10 percent of *P. radiata* and smaller amounts of other pines. This contrasts with New Zealand and Chile, where *P. radiata* is the chief species planted on a very large scale, which represents a serious risk of possible epidemic attack by insects and fungi. This risk should be reduced as much as possible by planting other fast growing pines and conifers, suited to the soils and climate, in reasonable proportions.

There has been about 70 years' experience of radiata pine in South Africa, for it was introduced there in 1870 and serious planting of the tree began in 1881. Laboratory tests and large-scale use of the species show that properly prepared mature lumber, say from trees at least 30 years old and of 15 inch (38 centimeters) diameter under bark at breast height, is equal to imported Scots pine (*P. sylvestris*) from northern Europe. The complaints of warping and excessive knots in radiata pine are unfair to the species. They relate only to immature timber from too young trees, semi-seasoned and ungraded. The same complaints would arise with lumber of that type from any other species of conifer.

The lumber of radiata pine as grown in South Africa is described as a white to light brown wood, medium hard, specially useful in building construction where strength is important. It is harder, tougher and stronger than the grade of European (Baltic) softwood, red or white, usually imported into South Africa, and no more resinous but rather less easy to nail. It is also valued for boxes and crates, especially where strength and rigidity are needed.

Most of the building timber of radiata pine is in sizes of 1 ½ inches (3.8 centimeters) by 4 ½ inches (11 centimeters) or 6 inches (15 centimeters), or 2 × 3 inches (5 × 8 centimeters). When such sizes are cut from log centers, at or near the pith or medulla, some distortion is apt to occur during drying; but with larger sizes such as 1 × 12 inches (2.5 × 30 centimeters) or 1 ½ × 9 inches (3.8 × 23 centimeters) there are few complaints. Where extra long beams of extra heavy sections are needed, Douglas fir or southern yellow pine from North America is used; the radiata pine plantations are not yet old enough to supply such beams.

Circular saws were almost universal in the earlier days of milling these pine logs but now all the larger State and private mills tend to use Swedish type gang or frame saws; and double log edgers are used on very small logs. The combination gives a high output of accurately sawn boards. The best results are got by drying the lumber in the maximum widths into which it can be cut, and then recutting to 2 × 2 inches (5 × 5 centimeters), 2 × 3 inches (5 × 8 centimeters) and such sizes only after the wood has approached the equilibrium moisture content of some 10 to 15 percent. If green logs are cut at once into 2 × 2 inches or 2 × 3 inches these sizes are apt to distort, because any spiral grain or compression wood is then more free to affect the shape. In wider pieces such abnormal wood is restrained during drying by the normal wood which is likely to be present in wider pieces, even if they have some abnormal wood in a part of their width. The danger of distortion is specially present near the pith, medulla or log center, in the juvenile wood of the first 12 or so years, as has been mentioned earlier.

As the green sapwood often has 100 percent moisture content and is very apt to become blue-stained, it is dipped in a stain preventive such as penta-chlorphenol unless it can be open-stacked at once, prior to kiln drying, or in areas with a dry climate can be put at once into narrow, well aired stacks, with their lowest

layers of lumber raised 12 to 18 inches (30 to 46 centimeters) above the ground, for ventilation. Close piling without stickers leads to blue stain and degrade, even if the wood has been dipped.

Government rules enforce preservative treatment of pine for house building in all coastal towns, because of the danger from the flying termite (*Cryptotermes*) and the house longhorn beetle (*Hylotrupes bajulus*). The latter is a great pest in North Germany, Scandinavia and other Baltic countries and has reached South Africa in imported softwood and has done serious damage there. It affects untreated sapwood; but 3 to 15 minutes cold soaking in penta-chlor-phenol or copper naphtenate dissolved in white spirits (alcohol) or paraffin protects pine sapwood completely and permanently for use inside houses, where it is not exposed to rain.

In 1945, the Forest Products Institute began to work out grading rules for pine in co-operation with the Lumber Millers' Associations. By 1948, these rules had been standardized and accepted. They provide for three grades of structural lumber, to be used as it is, without recutting, and three grades of factory lumber, which the user expects to recut into the pieces he may need for a wide variety of uses. With so much very green sapwood as there is in these fast grown pines it is most desirable to fix moisture content limits, and the grading rules do this. The grading applies to seasoned or dry wood, which is an immense advantage to the buyer or consumer, and in the end to the grower and seller also.

In the structural grades there has to be, and there is, a density clause, specifying the minimum weight of the wood at a known moisture content. This assures adequate strength and prevents the sale of pith or juvenile wood for structural use for which it is too weak and apt to distort. The structural lumber is graded on its poorer face and edge, because strength and not merely appearance is the vital point. The second and third grades are quite suitable for house building, the second being comparable with the 800 pound (363 kilogram) stress grade of the British Standards Institute, included in most of the building codes of the United Kingdom. The South African second grade of structural lumber also compares well with Swedish third class " deal " and North American No. 2 common lumber.

The factory lumber is graded on the better face and edge of each piece, because appearance rather than strength is the critical feature. A main object in introducing these grades was to provide an outlet for pieces rejected for structural use but quite suitable for many other uses, either whole or after recutting. There is no density or weight of wood clause for the factory grades, again because in them the strength is not the critical feature it is in structural lumber. Larger knots and knot clusters are allowed in the factory grades but knot holes and discoloration are more strictly limited, because of their effect on the appearance of the pieces.

The final proof of the success of radiata pine and other fast growing pines in South Africa is that the Forest Department of that country has been empowered to increase its rate of planting greatly, to the present level of 12,000 to 14,000 hectares per year.

New Zealand

Reports on utilization studies of this pine in New Zealand are not fully available in Chile. However, in the pulp and paper field the use of radiata pine has been studied intensively in New Zealand (and Australia). At least one chemical pulp mill is already operating there on this pine, and the building of a very large plant for integrated use of the tree in the North Island of New Zealand, about latitude 38° South, has begun. (This line of latitude falls in Chile between Concepción and Temuco). The site of this Marupara Project is about 140 miles (225 kilometers) southeast of the city of Auckland, near Rotorua and south of Tauranga Harbour (Bay of Plenty). The press reports speak of an annual cut of 600,000 tons, on a sustained yield basis, from a planted area of 104,000 hectares (the Kaingaroa State Forest), with an investment of U.S. $ 40-80 million of New Zealand, Australian and U.K. capital, in pulp and paper mills, lumber mills, a hydro-electric scheme, 40 miles (64 kilometers) of special railway lines linking the forests, mill sites and the coastal railway system, and a deep water wharf for export of the products.

Weight and strength tests of New Zealand *P. radiata* lumber growing as fast as $2\,^3/_4$ annual rings per inch were in 1945 reported to be satisfactory in comparison with U.S.A. data for *Pinus ponderosa* growing at only 19 rings per inch. Indeed, as in South Africa, it is knots and spiral grain that give more trouble in the grading and use of the lumber than rapid growth; and in spite of these defects the pine of New Zealand finds increasingly wide use at home and an export market in Australia.

A useful study of building timbers in New Zealand published in 1950 by the Forest Research Institute contains many references to *P. radiata* grown in New Zealand and its satisfactory use in all parts of buildings if properly graded, dried and where necessary treated with preservatives. The standard native wood for houses is or was rimu (*Dacrydium cupressimum*), a naturally durable wood related to Chilean mañio (*Podocarpus spp.*). In strength tests, dry radiata pine comes out very close to, but slightly stronger and harder than, dry rimu; and the pine is easier to dry without distortion and to nail when dry. The bulletin points out the importance of drying the pine thoroughly before installing it in buildings, of protecting it from too rapid changes of moisture content (due to weather) by good coatings of a sealing primer and of paint, and of treating it with a wood preservative where the risk from fungi or insects justifies such treatment. It also mentions especially the tendency to distort or warp shown by light weight wood from the pith or heart center of the tree, or near it, as has been found in South Africa.

With the approaching exhaustion of the naturally durable rimu and other such trees native to New Zealand, there is increasing use of *P. radiata* treated with preservatives. Creosote is much used where it is suitable, and water soluble salts such as copper sulphate or fluoridephenol with a chromium fixative against leaching out, where a clean, non-staining or paintable surface is required. Even the very cautious authorities which advance money for house building now permit the use of *P. radiata* if it has been properly treated with preservatives.

Australia

The *P. radiata* plantations of this country are mainly in the State of South Australia. Valuable studies have been made there on the silviculture of the species, specially thinnings; and the wood has been tested for weight and strength at the very active and well-staffed Forest Products Laboratory at Melbourne in the State of Victoria. The trees show a growth pattern changing from 2 ½ to 3 annual rings per radial inch at 11 years old to 4 ½ to 5 rings per inch at 26 to 40 years old, very much as in South Africa and Chile, and satisfactory strength.

The range of acceptable uses is remarkable, in spite of the fast growth. It includes ammunition boxes, flooring, house framing and roofing timber, weather boards, joinery, fruit and dairy cases, plywood, match splints, paper, cardboard and wallboard. A South Australian Bulletin of 1950 says:

> " In fact, without radiata pine flooring, there would have been no housing program except at a greatly increased cost for imported timber, if this could have been obtained. "

Chile

There is already a brisk trade in the lumber of *Pinus insigne* in Chile. One sees it everywhere in Santiago, in boxes, palisades, concrete shuttering, furniture, panelling and many other products. It is relatively cheap and easy to dry and use, compared with the native hardwoods which grow further from the capital, are heavier, harder, slower to dry and more apt to distort, on the whole, and are dearer. Use of radiata pine for pulp and paper is already being made by the leading pulp and paper firm of Chile, Cía de Papeles y Cartones, and large schemes for other companies to make pulp and paper of this pine are afoot. The prospects are bright, but the following considerations should be borne in mind:

1. Co-operation is extremely desirable between the large and small owners of pine stumpage or plantations, the manufacturers and the consumers, so that the whole industry of growing, reaping, manufacturing and use of the finished products may thrive on a continuing basis.
2. The rich technical experience on pulp, paper and other such products from resinous pine, available in Australia, New Zealand and South Africa and the U.S.A. should be used as fully as possible.
3. The possibilities for integrated uses of the pine deserve attention, that is to say, the development of plants which can put different sizes and grades of the logs and their leavings to different uses, such as lumber, pulp and paper, fiberboard, etc. The great Marupara project now under way in New Zealand is an example: its progress should be watched by Chile.
4. Good markets for thinnings are specially desirable and need organizing and developing. Wood preservation is a vital help in finding uses for posts and poles from thinnings. So, too, can be the special machinery developed in Scandinavia, New Zealand, the United Kingdom and elsewhere for sawing very small diameter logs into useful lumber.

As to sawn lumber, many of the main p[illegible] already been discussed. These and some [illegible] summarized below:

1. The pine should be cut to the sizes really ne[illegible] by the chief markets, as far as possible. At present, much radiata pine is cut in too short lengths. One reason given is that the extraction roads have too sharp curves to allow longer logs to be brought out; another that the equipment will not handle longer logs. Roads and equipment should be altered as soon as is possible and economic.
2. Blue stain should be avoided by simple and cheap dipping in anti-stain liquids, and the pine should never be close piled, even after dipping.
3. Lumber should be adequately dried, in the open air or kilns, a relatively quick and easy matter, before it is railed or sold to the consumers. The smaller sizes should not be cut straight from the green logs, if that can be avoided, but recut from wider sizes after these have dried to approximate equilibrium with the air around them.
4. Good grading is vital to adequate prices, satisfied consumers and repeat orders. Trial grading rules are being tested in practice. If found satisfactory they should be adopted; and, if found unsatisfactory, they should be modified until they are acceptable.
5. Preservative treatment is essential to certain, but not all, successful uses of *radiata* pine in Chile. This has been found to be the case with the same timber in New Zealand, South Africa and Australia. The large amount of sapwood in fast grown pine makes such treatment inevitable for many uses. Fortunately, the wood is permeable and easy to treat. Once treated adequately it is certain to give an excellent life, even in the ground and where termites and other pests occur.

Certain factors have come to be considered advantageous in the growing of the tree in Chile for uses other than pulp and paper, that is to say primarily for sawn lumber, with posts and poles as subsidiary products, chiefly from thinnings. These are as follows:

1. The pine should be grown to some 30 years of age before clear felling the main crop. If it is felled before it is 30 years old, the lumber output is bound to be of a lower average grade, with more knots and a greater proportion of juvenile or pith-wood, weaker and more apt to distort than older adult wood.
2. Thinning should be adequate and timely to get a larger average diameter in the final crop trees sooner, and to reap intermediate returns from the thinnings as posts, poles and small size lumber fit at least for boxes.
3. An early start should be made to the pruning of the lower side branches of all or a selected proportion of the trees expected to form the final crop, if labor is available and cheap enough. This can raise the average grade and value of the lumber greatly, if the pruned knotty core is small and an adequate thickness of

clear wood without any knots forms around the pruned core before the tree is felled. Unless it is early enough, pruning is a waste of money and labor.

The recent survey of this species by the Corporación de Fomento de la Producción shows that there are estimated to be some 173,000 hectares of plantations of various age classes. The first essential is clearly to protect these very valuable forests against fire and possible epidemic attacks by insects and fungi. Fire protection is outside the scope of this paper but is a well-known subject on which ample literature and advice are available from other countries. It is simply a matter of providing the necessary money and staff to insure adequately against heavy losses by fire.

There are grave risks from insects and fungi when very large areas of a single tree species are grown pure. Attention is therefore invited to the following warnings on this vital matter:

1. The article by Professor J. S. Boyce of Yale University, U.S.A., "Introduction of exotic trees, dangers from diseases and insect pests," in *Unasylva*, March 1954 (Vol. VIII, No. 1). He cites a deplorably long list of troubles and failures with exotics in Europe and elsewhere, but agrees that so far radiata pine in the Southern Hemisphere has been a success. He says, however, that "such extensive planting of pure stands is extremely risky", although the short rotation on which it is grown, and other factors, make the financial risk less than it would be with a longer rotation such as 50 years.
2. South Africa has roughly the same area of exotic pine plantations as Chile but no one species makes up more than 26 percent of the total area. The risk is spread over eight species, and radiata pine is only 10 percent of the total pine crop.
3. New Zealand, like Chile, has very great areas of pure radiata pine. The risks of epidemic disease there on account of these pure crops are regarded very seriously by all concerned who know the facts and past experience elsewhere. Rightly, the risks have not been allowed to stop large capital investment in New Zealand's exotic pine for pulp and lumber; but it is to be expected that future planting there will spread the risk to a greater extent by using a number of species, as in South Africa.

It is clear that, in future, Chile should spread, and so reduce the risk of disease in her pine plantations, by using other fast growing conifers as well as radiata pine. Two further points on future planting should be made, apart from the basic one, that planting must keep pace with felling in order to maintain supplies or achieve what foresters call a sustained yield. Firstly, the health and fertility of the soil must be safeguarded, especially if crops are being grown pure on a short rotation and clear felled. The painful experience of German foresters with spruce (*Picea abies* or *excelsa*) in Saxony should not be forgotten. There are techniques by which trouble can be avoided if the soil is studied and tended properly. Secondly, it will pay handsomely if the seed for future planting is sought as much as possible from superior types or races of radiata pine, particularly as to a minimum of spiral grain, and as to a light or fine system of side-branching, avoiding the types of trees with coarse side-branches which give rise to large and numerous knots in the lumber.

This paper has not dealt in any detail with the silviculture of *P. radiata* or its very important value for paper pulp. It should be mentioned, however, that the species is very easy to grow and to regenerate, either artificially or naturally. Also, as one would expect from its affinity with the southern yellow pines or pitch pines of the southeast U.S.A., the species is proving a most valuable material for paper pulp, both mechanical and chemical. The great development of the pulp and paper industry, based on similar pines, in southern U.S.A. in the last 20 or so years; the great mills for pulp and paper making now operating or being built in New Zealand; and the successful use of the tree by the pulp and paper industry in Chile itself point to a bright future and great developments in this field.

LONDON CALLING

As a contribution towards publicizing the Fourth World Forestry Congress, the General Overseas Service of the British Broadcasting Corporation has broadcast a series of seven talks under the title "Root and Branch" in which a number of forestry experts tell the story of the world's forests and of what they mean to man.

The series was introduced by Jack Westoby, an economist on the staff of the Forestry Division, FAO, who discussed the wide variety of uses to which timber is put and the astonishing number of products which can be made from wood. He referred to man's abuse of forests and to the acknowledgement of all foresters today that such abuse must end.

Sir Henry Beresford-Peirse, the Deputy Director-General of the British Forestry Commission, took up the story by giving an answer to the deceptively simple question: "Has the world enough trees?". Cut to one word only, his answer is "No" but it is a qualified negative. The world as a whole may have enough trees, but they are unevenly distributed so that many countries are very badly off; and to agriculturists, for example, it is the vital role of trees in protecting the surface of the earth which makes a reasonably even forest cover so desirable.

The next four speakers considered these and similar problems in relation to a particular region of the world. Egon Glesinger, Deputy Director of the Forestry Division of FAO and Director of the Timber Division of the Economic Commission for Europe, discussed the situation in Europe, where forest management standards are fairly high but where the demands on timber are often more than the forests can bear.

M. A. Huberman, Chief of the Silviculture Section of the Forestry Division of FAO, took as his subject forestry in the New World and in Latin America, which between them produce almost every known variety of timber.

Sir Herbert Howard, secretary of the Commonwealth Agricultural Bureaux and formerly Inspector-General of Forests for India, discussed some of the problems in Asia and the Near East, and Professor H. G. Champion, of the Oxford University Department of Forestry, dealt with forestry practices in Africa, Australia, and New Zealand.

Finally, Dr. P. V. Cardon, Director-General of FAO, summed up the series with a talk on the ideas and ideals behind the Congress taking place at Dehra Dun.

Physiology of Manual Work in Forestry

by H. Glaser
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Few kinds of employment entail such heavy work as forestry. Logging, in fact, is one of the types of human effort that require the highest calorie consumption, and the old-fashioned, back-breaking labor that it involves has no doubt been the principal reason why so many young country workers have rejected work in the woods and turned instead to the lighter and machine-aided tasks available in the towns.

In the forests of Europe the use of machines is still exceptional: felling and conversion, and in many cases also the hauling of wood, has to be carried out by manual labor. It is for this reason that physiological methods of research have been developed in forest work science in Germany over the past twenty-five years. Over this period very close co-operation has been maintained between the Max-Planck-Institut für Arbeitsphysiologie in Dortmund and the centers concerned with purely forest work science, a line of investigation started 30 years ago by Professor Hilf, now at Reinbek, University of Hamburg.

Research was first concentrated on the most efficient forms of cross-cut saws and the techniques of hand sawing. E. G. Strehlke reported on this early research work in his book *Die Methodik des Sägeversuchs*. The present writer continued Strehlke's work and published some further results, from which the most interesting points to emerge were:

1. An optimum radius of curvature of the teeth line is 2.5 meters for triangular-toothed saws for sawing pine wood.
2. A minimum length of saw is 1.4 meters for sawing logs of 30 centimeters diameter.
3. Sawing with higher pressure improves the work efficiency; therefore sawing with two hands is more economic than with one hand, and crosscutting of logs lying on the ground is better performed by workers in a kneeling position than when standing.

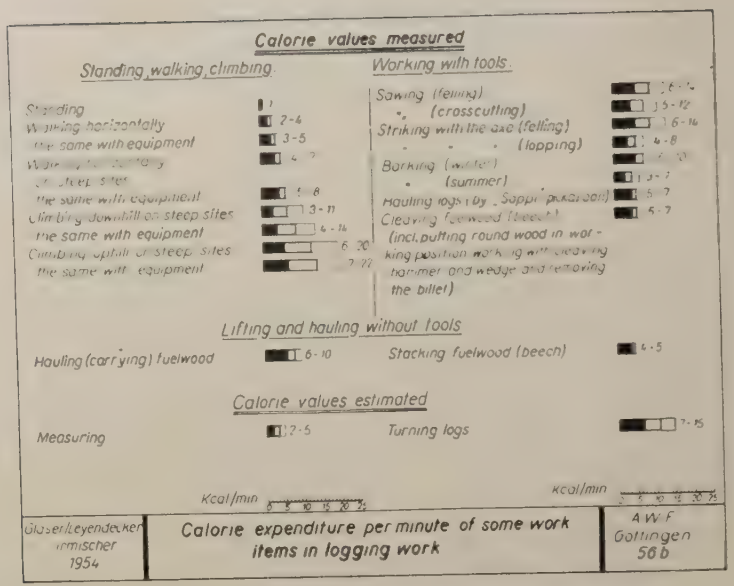
In the years before the war, E. Stentzel continued this research and found that the optimum rhythm for sawing was rather slow and that sawing slowly but with pressure was more efficient than sawing quickly and without pressure. In the case of raked-toothed saws, those results have lately been confirmed by Grandjean, Egli and Steinlein in Switzerland. In the writer's laboratory at Hannover-Münden, University of Göttingen, physiological research on one-man sawing was started again last year, but results are not yet available.

Another extraction operation entailing physiological strain is the hauling of billets by wheeled cart or by carrying to the nearest forest road. This work was examined before the war, by K. Plouda, who published his findings in respect to fuelwood. He found that on uneven ground where extraction by cart was impossible, carrying of billets on the shoulder and below the arms was most efficient. Generally, transport by vehicle is always more efficient, even for short distances of 15 meters.

In mountain areas, where wood is normally transported by sledge, carrying or drawing empty sledges uphill is very heavy work. G. Kaminsky of the Institut für forstliche Arbeitswissenschaft, Reinbek, used respiration test methods to check this and at the same time an instrument for measuring the pulse rate developed by E. A. Müller. The results showed very high figures of calorie consumption, exceeding all other known values for forest work. The practical implications are that only young and very strong workers are able to perform this kind of work, the very type that are becoming more and more difficult to find.

After the war, research on physiology of human work in forestry was begun at the Abteilung für Waldarbeit und Forstmaschinenkunde in Hannover-Münden, University of Göttingen. There were at first many difficulties to be overcome, but helpful assistance was given by the Max-Planck-Institut at Dortmund and by Professors Lehmann and Müller. We now have a small laboratory with three pieces of Haldane apparatus for

Respiration test with a Douglas bag in making the undercut.



Caloric expenditure per minute of some items in logging work.

analyzing gas-samples, and we are working with Douglas bags and also portable gas-meters.

The first forestry tool on which intensive research was made was the axe. In order to ascertain the rate of efficiency, we had to measure not only the human energy in calories by respiration tests but also the result of one axe stroke in kilograms. Without going into technical details of the methods used for this purpose, which involved the use of test harness to measure force of stroke, the results may be summarized as follows:

1. The optimum weight of a hammer used both for vertical and horizontal strokes is about 2.5 kilograms.
2. For striking a point near the soil a more efficient performance is given by a worker in a standing than in a kneeling position.
3. The optimum working rhythm with a hammer or an axe is about 25 to 35 strokes per minute.
4. A stroke with full power consumes less calories per kilogram than a stroke with half the force.
5. An optimum for length of handle is about 70 to 80 centimeters and this optimum is valid for all weights of hammers (between 1 and 4 kilograms) and also for both vertical and horizontal direction of stroke.

In comparing the results of these investigations to work with real axes, we always used the same axe, loading it with additional weights, the shape and sharpness of the cutting edge did not therefore have any influence on the results. We found that for making the undercut for felling (that is for horizontally directed strokes) and for making a notch in a lying log (that is for vertically directed strokes), both for softwood and hardwood, efficiency of work increased with the weight of axe up to an optimum of about 1.8 kilograms. This optimum is less than that for the experimental tests with hammers since heavy axes tend to remain fixed in the wood requiring additional time and energy for drawing them out again.

Laboratory research has also been carried out on a number of other operations in forestry work. H. Leyendecker investigated the operations of whole working day according to the "*Arbeitsschauuhr*" of Poppelreuter. He found that the calorie consumption of all the workers he had under observation in all parts of Germany varied only between the narrow limits of about 300 to 350 calories per hour. This was true for all types of logging work investigated, from felling small spruce to large beech.

Later on we found the same applied to logging work on steep hill sites. Although climbing and walking on steep slopes is the kind of work which shows the highest calorie expenditure per minute, we found that the total calorie consumption for a whole day's work was not higher than for logging work on level sites which amounted also to only 300 to 350 calories per hour. From this it may be deduced that in logging work, men adjust themselves to a limit of human effort represented by a calorie consumption not exceeding about 300 to 350 calories per hour. Research at the Max-Planck Institut has also shown that there exists an upper limit of human energy turnover for a day's work at a figure of about 2,000 to 2,500 calories per day, corresponding to the 300 to 350 calories per hour for a working day of seven hours as was generally observed in our forest work. Experiments in Sweden some years before by Zotterman and Lundgren yielded higher figures than those which we obtained, but these tests dealt with one-man work, a method of operation usual in the Scandinavian countries whereas two-man team work is commonly practised in Germany. The high calorie consumption for work in Sweden is perhaps due to the fact that workers there usually live in logging camps for only part of the year and are keen on making as high earnings as possible during the short time away from their families, so that they perhaps exceed the upper limits of calorie turnover observed among German workers.

Human work in forestry still presents many interesting problems for research. Since the use of machines in forestry has definite limitations, the improvement of the productivity of forest work may often lie largely in research on hand tools and working techniques by physiological methods. Research at present seems to be restricted to Germany, Switzerland, Finland and Sweden. Doubtless, it will soon be extended elsewhere.

Composition of Turpentines of Mexican Pines

by N. T. Mirov [1]

A large area of Mexico is covered with pine forest (*See* map). On the lower slopes of the northwestern desert ranges are found nut pines, called *piñones*, and at higher elevations are excellent stands of *Pinus engelmannii*, *P. cooperi*, *P. durangesis*, *P. arizonica*, and some lesser species. Southward, pine forests are to be found most extensively along the Sierra Madre Occidental, which extends parallel to the Pacific coast southeasterly as far as the State of Jalisco. Along the Atlantic coast, between the central plateau and the Gulf coastal plains, is the Sierra Madre Oriental, its several mountain chains protruding into the deserts of northeastern Mexico and extending south to the State of Puebla: it is much narrower than Sierra Madre Occidental and its pine forests are not as extensive. Connecting these two ranges, from southeastern Jalisco to Puebla, are numerous short mountain chains and plateaus covered with stands of pines, seriously depleted in some places but in others fully stocked and, as in Michoacan, still occupying large areas. The continuation of the pine-covered mountains southeast of Michoacan is known as Sierra Madre del Sur. At the Istmo de Tehuantepec the mountains disappear, but farther east, in Chiapas, is located a highland covered with pine forests that extends into Guatemala.

The peninsula of Baja California has several desert ranges, such as Sierra de San Pedro Martir. On the higher elevations of this plateau-like range are found *Pinus contorta* forests and park-like stands of *Pinus jeffreyi* with an occasional admixture of *P. lambertiana*; in the lower elevations scattered pinyon pines (*piñones*) occur.

The largest pine forests are found (in order both of area and timber volume) in Durango, Chihuahua, Michoacan. México, Veracruz, and Coahuila.

Martinez recognizes 66 different pines in Mexico. Of them, 39 are given species rank, and 27 are given varietal rank. Possibly, some of the pines regarded by Martinez as species, such as *P. remorata*, will be reduced to varietal rank, whereas others, such as *P. pseudostrobus* var. *oaxacana*, will be elevated to species rank. In any event, no other equal area of the earth is host to so many different pines.

The great diversity of pines in the tropical highlands of Mexico suggests that the environment of this region has been highly inducive to mutation among the pines. Among the mutagenic agents that may have contributed to the remarkable diversification of pines in these highlands may be mentioned ultraviolet radiation, which is higher there than at low elevations, and cosmic ray particles which are more abundant there and carry more energy than in more northerly latitudes.

It seems probable that the topography and climate of the region are particularly favorable not only for the survival of mutants, but also for the production and survival of hybrids. Coffee and banana plantations, intermingled with pine groves, flourish within sight of snow-capped peaks whose slopes are covered with pine forests. Thus, pollen of high-elevation *P. hartwegii*, for example, may reach stands of lower-elevation *P. montezumae* (and vice versa) within a few minutes. The mild and uniform temperature of early summer, together with adequate precipitation during the long growing season, probably favor natural crossing and the establishment and survival of seedlings.

All these conditions seem to explain the unbelievable variability of pines in the tropical highlands of Mexico. Many States have more than a dozen different pines, counting both species and varieties (Table 1).

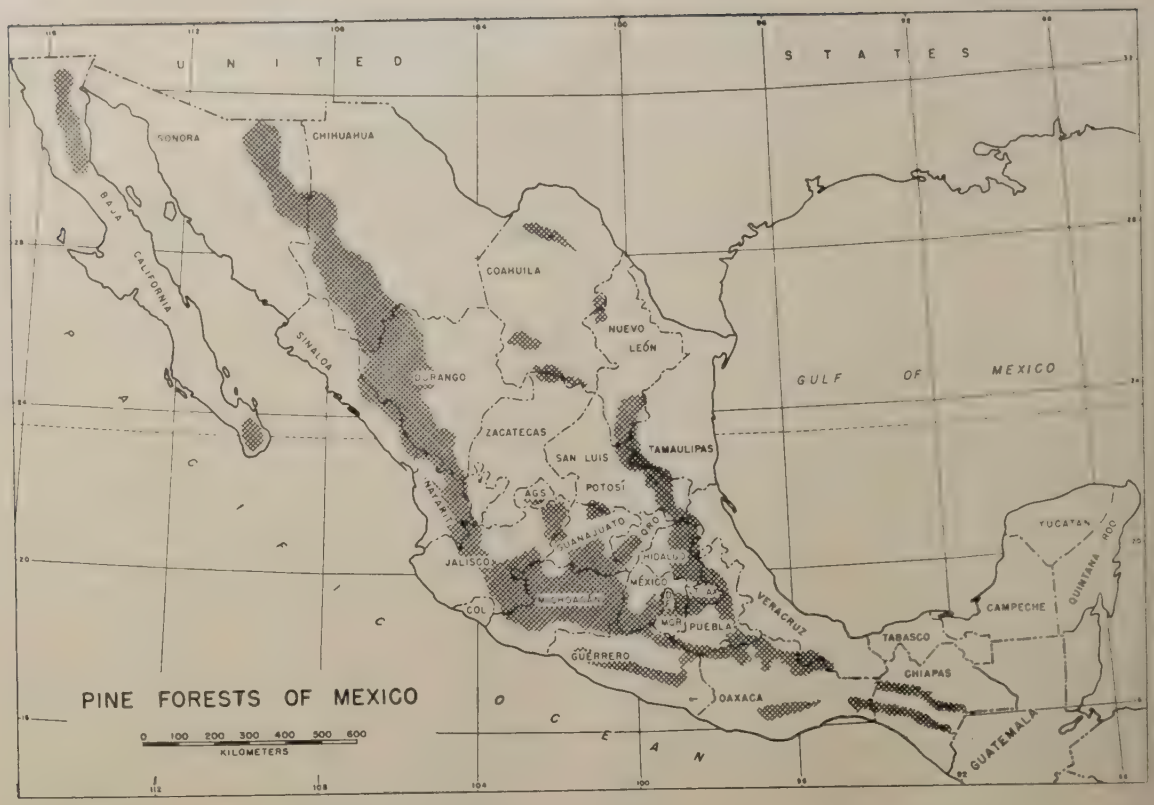
Table 1. – Distribution of Pines in Mexico by States [1]

State	Number of pines	State	Number of pines
Aguascalientes	2	Nayarit	11
Baja California	14	Neuvo Leon	12
Campeche	none	Oaxaca	18
Coahuila	11	Puebla	15
Colima	none	Quintana Roo	none
Chiapas	11	Queretaro	5
Chihuahua	12	San Luis Potosi	5
Durango	16	Sinaloa	9
Guanajuato	3	Sonora	7
Guerrero	10	Tabasco	none
Hidalgo	12	Tamaulipas	6
Jalisco	17	Tlaxcala	8
México	17	Veracruz	12
Michoácan	16	Yucatan	none
Morelos	9	Zacatecas	12

[1] Source: Martinez, Maximino. *Los Pinos Mexicanos*, pp. 57-61.1948.

[1] Contribution from the Institute of Forest Genetics, a branch of the California Forest and Range Experiment Station, which is maintained at Berkeley, California by the Forest Service, U.S. Dept. of Agriculture in co-operation with the University of California.

The work reported in this paper was aided through a grant from the Rockefeller Foundation.



In Mexico, pines generally grow at elevations between 1,800 and 3,800 meters. *Pinus hartwegii* is a pine growing at the highest elevations, reaching the snowline. Pines growing in relatively low altitudes are: *Pinus lawsonii*, *P. pringlei*, and *P. strobus chiapensis*. *P. strobus chiapensis* has been observed by Martinez at 800 meters above sea level often growing among coffee and banana plantations. Possibly, *P. caribaea* may be growing at sea level along the coast in Quintana Roo.

Turpentine and rosin industry

Production of turpentine and rosin (*resinación*) is a well-established industry of Mexico. The principal species tapped are: *Pinus montezumae*, *P. michoacana*, *P. leiophylla*, *P. pseudostrobus*, *P. teocote*, *P. oocarpa*, and *P. hartwegii*. The French system of tapping is used in all regions.

The annual production of oleoresin (*resina*) amounts to 30,000 metric tons. Michoacan is the leading producer, followed by Jalisco, México, Puebla and Oaxaca. Turpentining in the northern States, Durango and Nuevo León, has been discontinued. Data on oleoresin production in Mexico, kindly supplied in March 1954 by Señor Ramón Martín del Campo, Vice-President of the Unión de Resineros, is presented, in Table 2.

As this Table shows, the largest turpentining operations are not necessarily located in the largest forest areas of Mexico, but rather in the warmer parts of the country, where resin yield is higher than in the north. (Pine forests of Chiapas are not yet exploited for turpentining because of their remoteness from industrial centers.)

Table 2. – Oleoresin Production in Mexico

Locality	Oleoresin production in metric tons
Uruapan, Michoacan	8,000
Morelia, Michoacan	5,000
Ciudad Hidalgo, Michoacan	8,000
Jalisco (mostly Guadalajara)	4,500
State of México	2,500
Puebla	1,000
Oaxaca	1,000
Total	30,000

From the 30,000 metric tons of oleoresin, the operators distill about 5.1 million kilos of turpentine, or about 17 percent of the weight of crude oleoresin. Of this amount, 25 percent is consumed in Mexico, while 75 percent is exported to the United States, chiefly to Los Angeles, San Francisco and some cities of Texas.

Mexican turpentine distilleries are modern, using pretreatment and filtering of oleoresin and employing steam distillation. The turpentine and the rosin are of excellent quality.

Until recently, very little was known about the chemical composition of turpentines of Mexican pines. In 1946, Ing. José Iriarte reported on the compo-

Table 3 – Composition of Turpentines of Mexican Pines

No	Name	Reference see end of article pp. 172-173	Where growing [1]	Physical characteristics of turpentine: Density d_4^t	Physical characteristics of turpentine: Index of refraction n_D^t	Physical characteristics of turpentine: Specific Rotation D	Physical characteristics of turpentine: Yield of turpentine percent	Chemical composition of turpentine, percent	Remarks
1.	*P. arizonica* Engelm.	(9 p. 292)	Son., Coah., Dgo. Its variety Stormiae grows in Coah. and N.L.					Not yet known.	An important timber tree of Mexico.
2.	*P. attenuata* Lemm.	(9 p. 355)	Near Ensenada, Baja California	$.8520_4^{23}$	1.4652^{23}	+ 17.1	24.0	p, dl-α-pinene, 98.	Of no commercial importance.
3.	*P. ayacahuite* Ehr.	(9 p. 111) (13)	From Chih. to Chis. There are three distinct variations of this pine.	$.8194^{25}$	1.4528^{24}	+ 7.9	17.0	n-heptane, 20; dl-α-pinene 70; terpinolene 5; bicyclic sesquiterpene 3; (m. p. hydrochloride 108° C.)	Sample analyzed was from Chiapas.
4.	*P. cembroides* Zucc.	(9 p. 82) (13)	B.C., Son., Chih., Coah., N.L., Zac., Tamps., Dgo., S.L.P., Tlax., Hid., Jal., Ags. Qro., Mex., Ver., Pue.	$.8471^{22}$	1.4680^{21}	+ 45.2	26.0	d-α-pinene 92; dl, l-limonene 4; a sesquiterpene, d-longifolene 2.	Sample analyzed was from between Parras and Saltillo, Coah.
5.	*P. chihuahuana* Engelm.	(9 p. 144)	Chih., Coah., Dgo., Zac., Nay., Jal.	$.864C^{24}$	$1.4669^{24.5}$	— 22.0	20.0	1-α-pinene 50; β-pinene 20; limonene 20; d-longifolene 8.	Closely related to *P. leiophylla*.
6.	*P. contorta* Dougl.	(9 p. 342) (20)	Sierra de San Pedro Martir, B.C. 2,400 to 3,000 meters.	$.8452^{25}$	1.4828^{25}	— 15.0	15.0	d-α-pinene, traces or none; l-β-phellandrene 96+.	Grows chiefly in western United States, Canada, and Alaska.
7.	*P. cooperi Blanco*	(1) (9 p. 242)	Durango 2,500 to 2,700 meters	$.8580^{25}$	1.4705^{25}	+ 2.9	25.0	dl, d-α-pinene 56; β-pinene 40; unidentified higher boiling material 3.	Previously known as *Pinus lutea* Blanco.
7a.	*P. cooperi* var. *ornelasi* (Mart.)	(1) (9 p. 246)	Durango S. W. of Chihuahua.	$.8615^{23}$	1.4728^{23}	+ 5.2	29.4	dl, d-α-pinene 80; β-pinene 15; unidentified higher boiling material 4.	Previously known as *P. lutea* var. *ornelasi* Mart.
8.	*P. coulteri* D. Don	(9 p. 341)	Sierra del Pinal, B.C. 1,600 meters.	$.8505^{15}_{15}$	1.4767^{25}	— 15.2	16.9	n-heptane 5; l-α-pinene 30-35; l-β-phellandrene 35-45; n-undecane 10.	Rare pine.
9.	*P. douglasiana* Mart.	(10) (9 p. 180)	Sin., Nay., Jal., Mich., Mex., Oax.					Not yet known.	Closely related to *P. pseudostrobus*.
10.	*P. durangensis* Martinez	(9 p. 224) (4)	Western parts Dgo. and Chih.	$.8566^{22}$	1.4702^{21}	+ 15.4	25.0	d, dl-α-pinene 71; β-pinene 19; d-cadinene 3; tests for carene negative.	Is good producer of resin.
11.	*P. edulis*	(9 p. 89) (20)	B.C., Probably Son. and Chih.	$.8680^{15}_{15}$	1.4707^{15}	+ 22.2	20.0	d-α-pinene 75; l-limonene 5; cadinene-like sesquiterpenes 20.	May be commercially important.
12	*P. engelmannii* Carr.	(9 p. 280) (18)	Son., Chih., Sin., Zac., and Dgo.	$.8648^{21}$	1.4695^{25}	+ 42.0	22.5	d, dl-α-pinene 70-80; β-pinene 2; dipentene 2; d-longifolene 12.	Also known as *Pinus apachecа*.
13.	*P. flexilis* James	(2) (9 p. 106)	N.L., Coah. and B.C., possibly in Chih.	$.8606^{25}$	1.4707^{28}	+ 41.2	20.0	dl, d-α-pinene 80; albicaulene 13; a bicyclic sesquiterpene 7; a monocyclic sesquiterpene present.	Sample analyzed was from southeastern California.
14	*P. greggii* Engelm.	(9 p. 337)	Coah., N.L., S.L.P., Hgo.					Not yet known.	
15.	*P. harbergii* Lindl.	(7), (8), (9 p. 232)	D.F., Mex., Tlax., Hgo., Mor., Mich., Oax., Chis., Ver. up to 4,000 meters.	$.8637^{21}$ $.8480^{23}$	1.4653^{23} 1.4705^{23}	+ 2.5 — 48.7	27.7 29.7	d, dl-α-pinene 65; l-limonene, small amount. d, dl-α-pinene 28; β-myrcene 11 Δ^2-carene 5; l-limonene 46; methyl chavicol 3; longifolene 1-2.	

[1] *Abbreviations of State and Territory names are as follows*: Ags. - Aguascalientes; B.C. - Baja California; Camp. - Campeche; Chih. - Chihuahua; Chis. - Chiapas; Coah. - Coahuila; D.F. - Distrito Federal; Dgo. - Durango; Gro. - Guerrero; Gt. - Guanajuato; Hid. - Hidalgo; Jal. - Jalisco; Mex. - Mexico; Mich. - Michoacan; Mor. - Morelos; Nay. - Nayarit; N.L. - Nuevo Leon; Oax. - Oaxaca; Pue. - Puebla; Q.R. - Quintana Roo; Qro. - Queretaro; Sin. - Sinaloa; Son. - Sonora; Tab. Tabasco; Tamps. - Tamaulipas; Tlax. - Tlaxcala; Val de M. - Valle de Mexico; Ver. - Veracruz; Yuc. - Yucatan; Zac. - Zacatecas.

TABLE 3 – COMPOSITION OF TURPENTINES OF MEXICAN PINES (*Continued*)

No.	Name	Reference see end of article pp. 172-173	Where growing [1]	Physical characteristics of turpentine: Density d_4^t	Index of refraction n_D^t	Specific Rotation D	Yield of turpentine: percent	Chemical composition of turpentine, percent	Remarks
16.	*P. herrerai* Martinez	(9 p. 166)	Jal., Sin., Gro., Dgo.					In progress.	Is a good producer of resin.
17.	*P. jeffreyi* Murr.	(9 p. 277)	B.C., from 1,000 to 2,500 meters.	.6951[15] to .7110[15]	1.3927[15] to 1.4060[15]		about 10.0	n-heptane 93-95; aldehydes (chiefly decyl) 5;	Common name is *Pino negro*.
18.	*P. lambertiana* Dougl.	(9 p. 126)	S. Pedro Martir, B.C. Is found chiefly in Oregon and California.	.8669[24]	1.4753[27.5]	— 7.46	18.4	1-α pinene 65; β pinene 13; bicyclic sesquiterpenes 10; sesquiterpene alcohol 2.	
19.	*P. lawsonii* Roezl	(9 p. 170)	Jal., Mich., Mex., Mor., Gro., Oax. In lower elevations.					In progress.	
20.	*P. leiophylla* Schl. et Cham.	(8), (9 p. 137) (12)	From Chih. to Oax. 1,500 to 2,500 meters.	.8515[28] .8640[25]	1.4633[22] 1.4733[22]	+ 23.0 + 32.0	20.6 26.3	d-α-pinene 90; Δ3-carene 8. d-α-pinene 90.	Vacuum distilled (12). Steam distilled (8).
21.	*P. lumholtzii* Rob. et Fern.	(9 p. 150)	Chih., Sin., Dgo., Zac., Nay.	.8455[23]	1.4723[23]	— 81.3	18.0	α-pinene 16; l-limonene 75; methyl chavicol 2; d-longifolene 1.	An excellent source of l-limonene.
22.	*P. michoacana* Mart.	(9 p. 252)	Mich., Jal., Oax., Chis., Nay., S.L.P., N.L., Ver., Gt., Mor., Pue., Zac., Mex., Dgo., Hgo.					In progress.	Has several varieties.
23.	*P. monophylla* Torrey	(9 p. 94)	Baja California and in the United States.	.8721[15] to .8733	1.4732[18] to 1.4733	+ 14.4 to + 17.3	19.0	d-α-pinene 85; limonene 4-5; cadinene-like sesquiterpenes 4-6.	Apparently crosses with other piñones (Nos. 4 and 37).
24.	*P. montezumae* Lamb. (from Michoacan)	(8), (9 p. 213) (12)	From Coah., to Chis. Is very variable.	.8757[24] .8563[23]	1.4656[22] 1.4655[22]	[2] + 36.5 + 47.7	22.7 27.6	d-α-pinene 96-97. d-α-pinene 97-98	Steam distillation (8). Vacuum distilled (12).
25.	*P. montezumae* Lamb. (from Chiapas)	(4) (9 p. 213)		.8441[23]	1.4612[23]	+ 19.2	25.0	n-heptane 8; d, dl-α-pinene 72; limonene 6-7; longifolene 8.	Apparently crosses with *P. rudis*, and *P. hartwegii*. Our results suggest possible hybridization with *P. pseudostrobus* var. *oaxacana*.
26.	*P. muricata* Don.	(9 p. 348) (11)	North part of B.C. and on nearby islands.	.8610[15]	1.4693[15]	+ 11.6	22.4	d-α-pinene 98; camphene less than 1.	Rare pine of no commercial value. Occurs mainly in California, U.S.A.
27.	*P. nelsoni* Shaw	(9 p. 101)	Rare pine of Coah., N.L. and Tamps.					Not yet investigated.	
28.	*P. oocarpa* Schiede (from Michoacan)	(9 p. 300)		.8569[23]	1.4656[23]	+ 47.5	24.8	d-α-pinene 98.	
29.	*P. oocarpa* Schiede (from Chiapas)	(3) (9 p. 300)	This pine and its varieties grow from Sonora and Sinaloa to Chiapas.	.8562[23]	1.4684[23]	+ 25.4	22.0	d, dl-α-pinene 68; limonene 22; longifolene about 7.	Composition of turpentine of *P. oocarpa* from Chiapas differs considerably from that obtained in the two northern locations.
30.	*P. oocarpa* var. *trifoliata*	(4) (9 p. 308)		.8588[24]	1.4682[23]	+ 39.8	23.0	d, dl-α-pinene 87; unidentified terpenes 5; longifolene 4-5.	
31.	*P. patula* Schlet. Cham.	(9 p. 327)	Qro., Hgo., Mex., D.F., Tlax., Puebla, Ver., Oax.					In progress.	Its variety *longipedunculata* grows in Oaxaca at altitudes of 1,900 to 2,000 meters.
32.	*P. pinceana* Gordon	(9 p. 97, 13)	Rare pine of desert ranges of Coahuila	.8434[25]	1.4753[25]	100.6	17.7	dl. 1-α-pinene 5; limonene 80; a new bicyclic sesquiterpene (maderene) 5.	

[1] A minus sign before the polarization value of *P. montezumae* turpentine in Iriarte's paper is obviously a typographical error.

TABLE 3 – COMPOSITION OF TURPENTINES OF MEXICAN PINES (*Concluded*)

No	Name	Reference section end of article pp. 172-173	Where growing	Physical characteristics of turpentine: Density d_4^t	Physical characteristics of turpentine: Index of refraction n_D^t	Physical characteristics of turpentine: Specific Rotation D	Physical characteristics of turpentine: Yield of turpentine percent	Chemical composition of turpentine, percent	Remarks
33.	*P. ponderosa* Laws	(5) (9 p. 272)	Widely distributed in the Western United States. Also apparently occurs in northern Mexico.	.8701[25.5]	1.4730[22.5]	+ 13.7	18.0	d, dl-α-pinene 34; β-pinene 14; Δ3-carene 31; limonene 4; longifolene 4; unidentified sesquiterpenes 4-5.	There are several chemical varieties of this pine. All are characterized by turpentine containing large quantities of 3-carene. Physical characteristics and chemical composition given here are for *P. ponderosa* from Arizona.
34.	*P. pringlei* Shaw	(9 p. 322)	Mich., Mex., Gro., Oax., from 1,750 to 1,850 meters.					Not yet known.	
35.	*P. pseudostrobus* Lindl. (typical)	(8) (9 p. 186)	From N.L. and Jal., to Ver. and Chis.	.8672[23]	1.4624[23]	+ 31.5		d-α-pinene 90; sesquiterpene in small quantity.	Abundant producer of resin. Includes 4 varieties. Apparently crosses with *P. montezumae*.
36.	var. *oaxacana* Mart.	(3) (9 p. 202)	Mex., Pue., Oax., Gro., Chis.	.7920[24]	1.4445[53]	— 10.5	17.1	n-heptane 21; d, dl-α-pinene 51; l, dl-limonene 15-16; undecane 1.3; d-longifolene 7.5.	Presence of large amounts of heptane is interesting. Appears to be an independent species.
37.	*P. quadrifolia* Parl.	(6) (9 p. 91)	Baja California	.8609 to .8668[23]	1.4732a to 1.4787	+ 16.2 to + 32.7	23.5	d, dl-α-pinene 62; ocimene 3.8; sesquiterpenes about 20; residue (probably mostly polymerized ocimene), 14.	Also grows in U.S.A. (California). Note large quantity of sesquiterpenes.
38.	*P. radiata* D. Don	(9 p. 351) (19)	Island of Guadalupe off Baja California	.8596[23]	1.4727[22]	— 5.8	16.8	dl-α-pinene 75; β-pinene 22.	Some strains have dextrorotatory turpentines. Also grows in U.S.A. (Calif.). Has been extensively planted in New Zealand, South Africa, S. America and S. Europe.
39.	*P. reflexa* Engelm.	(9 p. 108) (14)	Chih., and Dgo.	.4856[24]	1.4669[22]	0.0	17.7	n-heptane 5; dl-α-pinene 75; Δ3-carene 5; d-terpinolene 5; n-undecane 2-3; cadinene-like sesquiterpene 5.	The sample analyzed from Arizona.
40.	*P. remorata* Mason	(9 p. 347)	Cedros and Guadalupe islands near Baja California.					Not yet known.	Very rare. Of no commercial importance.
41.	*P. rudis* Endl.	(7) (9 p. 236)	N.L., Tamps., Zac., Nay., Hgo., Mexico., D.F., Pue., Oax.	.8627[24]	1.4734[23]	— 11.1	22.7	d, dl-α-pinene 32; β-pinene 62; dipetene 1; higher boiling fractions 1.	Apparently crosses with *P. montezumae* (9 p. 242).
42	*P. strobus* var. *chiapensis* Martinez	(9 p. 131)	Ver., Oax., Chia., can be found occasionally in Guatemala.					Not yet known.	
43	*P. tenuifolia* Benth	(9 p. 175)	Sin., Chis., Gro., May., Jal., Oax., Mich.					Not yet known.	Closely related to *Pinus pseudostrobus*.
44	*P. teocote* Schl. et Cham.	(9 p. 160) (17)	Widely distributed from Coah. and Dgo. to Chis.	.8578[23]	1.4669[21.5]	— 7.6	24.2	dl, d-α-pinene 92; sesquiterpenes (mostly longifolene) 3.	Is extremely variable. Grows in elevations from to 3,000 meters. The sample analyzed was from Salto, Dgo.

[1] *Abbreviations of State and Territory names are as follows:* Ags - Aguascalientes; B.C. - Baja California; Camp. - Campeche; Chih. - Chihuahua; Chis. - Chiapas; Coah. - Coahuila; D.F. - Distrito Federal; Dgo. - Durago; Gro. - Guerrero; Gt - Guanajuato; Hid. - Hidalgo; Jal. - Jalisco; Méx. - México; Mic. - Michoacán; Mor. - Morelos; Nay. - Nayarit; N.L. - Nuevo Leon; Oax. - Oaxaca; Pue. - Puebla; Q.R. - Quintana Roo; Qro. - Queretaro; Sin. - Sinaloa; Son - Sonora; Tab. Tabasco; Temps- - Tamaulipas; Tlax. - Tlaxcala; Val de M. - Valle de México; Ver. - Veracruz; Yuc. - Yucatan; Zac. - Zacatecas.

sition of turpentines of *Pinus montezumae*, *P. pseudostrobus*, and *P. leiophylla* from Uruapan, Michoacan and of *P. hartwegii* from Rio Frio, México. Iriarte's findings are incorporated in Table 3, which summarizes information on physical characteristics and chemical composition of the turpentines of Mexican pines.

In 1950, the author, with the assistance of the University of California, made his first oleoresin-collecting trip to Mexico. In 1952 and in 1954, grants from the Rockefeller Foundation enabled him to visit Mexico again. Materials collected during these three trips were analyzed in the laboratory of the California Forest and Range Experiment Station. The laboratory work also was supported by the Rockefeller Foundation.

It has been found that longifolene, a sesquiterpene which previously was reported only in two pines of India, is the most common sesquiterpene in Mexican (as well as in western North American) turpentines. Occurrence of a kerosene-like paraffin hydrocarbon, normal undecane ($C_{11}H_{24}$), in Mexican turpentines is of scientific interest; but another paraffin hydrocarbon, normal heptane (C_7H_{16}), which is found in at least 6 Mexican pines, is a product not only of scientific, but also of considerable practical importance. Heptane is used in testing motor fuels and commands a price (about U.S. $10.00 per liter) much higher than ordinary turpentine. On the other hand, its presence in ordinary turpentine lowers the quality of the product. Chemically pure n-heptane can be obtained from Mexican pines in a very simple manner.

Need for further research

It is seen from Table 3 that turpentine composition of 12 Mexican pines is still unknown. Some of these pines are not very important in the management of Mexican forests; others are. The complex and extremely variable species, *Pinus pseudostrobus*, its varieties, and the closely related species, such as *Pinus douglasiana* and *Pinus tenuifolia*, should be thoroughly studied. The turpentines of these pines should be carefully examined; great variations might be found in their composition. Another species that awaits investigation is *Pinus montezumae*. It is possible that natural crossing of this species with certain forms of *Pinus pseudostrobus*, gives rise to hybrids having turpentine unlike the turpentines of the parents. We have found that the turpentine of *P. montezumae* of Chiapas differs considerably from the turpentine of this pine growing in Michoacán. We are inclined to think that this pine crosses with *P. pseudostrobus* var. *oaxacana*.

Some of the compounds listed in Table 3, such as ocimene, methyl chavicol and camphene, occur only in a few pines and in very minute quantities. Others, chiefly terpenes like alpha-pinene ($C_{10}H_{16}$), are very common. Some Mexican turpentines consist almost entirely of alpha-pinene, which makes them suitable for use in manufacturing synthetic camphor. Beta-pinene is surprisingly rare in Mexican pines. Delta-3-carene, which is found in abundance in western United States, is rather rare in Mexico, while limonene (always in its laevo-form) is relatively frequent, being found in at least nine pines (Table 4) and in some of them, as *Pinus lumholtzii*, in very large quantities. Turpentine of *Pinus contorta* of Baja California consists almost entirely of 1-beta-phellandrene, a monocyclic terpene which may prove to be a valuable commercial product.

Among sesquiterpenes (that is, terpenes having the formula $C_{15}H_{24}$) of some possible commercial importance are the cadinene-like substances (i. e. sesquiterpenes that yield crystalline cadinene hydrochloride, but which are not necessarily identical with cadinene). These are used as fixatives (odor-carriers) in the perfume industry. *Pinus quadrifolia* is very rich in these sesquiterpenes.

TABLE 4. – CHEMICAL COMPOUNDS OF MEXICAN TURPENTINES

Compounds	Species
A. *Aliphatic hydrocarbons*	
n-heptane	P. ayacahuite, P. coulteri, P. jeffreyi, P. montezumae (Chiapas), P. pseudostrobus var. oaxacana (Chiapas), P. reflexa.
n-undecane	P. coulteri, P. pseudostrobus, var. oaxacana (Chiapas), P. reflexa.
ocimene	P. quadrifolia.
beta-myrcene	P. hartwegii.
B. *Monocyclic terpenes*	
dipentene	P. engelmannii, P. rudis, P. pinceana.
l-limonene	P. chihuahuana, P. edulis, P. hartwegii, P. lumholtzii, P. monophylla, P. montezumae (Chiapas), P. oocarpa (Chiapas), P. pseudostrobus var. oaxacana (Chiapas).
1-β (beta)-phellandrene	P. contorta, P. coulteri.
terpinolene	P. ayacahuite, P. reflexa.
C. *Bicyclic terpenes*	
α-(alpha) pinene	Present in all Mexican pines except P. jeffreyi and perhaps P. contorta.
β-(beta)[3] pinene	P. chihuahuana, P. cooperi, P. durangensis, P. engelmannii, P. lambertiana, P. radiata, P. rudis.
Δ-(delta)[3]-carene	P. hartwegii, P. leiophylla, P. ponderosa, P. reflexa.
camphene	P. muricata.
D. *Sesquiterpenes*	
longifolene	P. cembroides, P. chihuahuana, P. flexilis, P. hartwegii, P. lumholtzii, P. montezumae, (Chiapas), P. oocarpa (Chiapas), P. oocarpa var. trifoliata, P. pseudostrobus var. oaxacana (Chiapas), P. teocote.
albicaulene	P. flexilis.
maderene	P. pinceana.
unidentified monocyclic	P. flexilis.
unidentified bicyclic	P. ayacahuite, P. lambertiana.
E. *Alcohols*	
A sesquiterpene alcohol	P. lambertiana.
F. *Aldehydes*	
Decyl aldehyde	P. jeffreyi
G. *Phenolic compounds*	
Methyl chavicol	P. lumholtzii.

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NEAR EAST SEMINAR ON FOREST POLICY

During the period 13-25 September, the Turkish Government was host at Istanbul to a seminar on Forest Policy for Near Eastern countries.

This Seminar dealt with long-term forest policy in conservation of forests and range management, with particular emphasis on principles, delimitation, sustained yield, legislation, administration, and trends in forest research and education. It also covered such subjects as methods of implementing forest policy; publicity by means of tree festivals and public education; political aspects of the grazing problem; organizing protection against insect pests, diseases and fire; improvement of afforestation and plantations outside the forest; improvements in forest utilization, with particular emphasis on training of forest labor; products utilization through development of wood-using industries; and development of markets.

The Co-Director, J. Moser (FAO) and Fehim Firat (Turkey), reported a very successful seminar with the participation of twenty-one forest officers from Cyprus, Egypt, Iraq, Iran, Lebanon, Libya, Syria and Turkey. Lecturers included H. Benan (Iran), G. Chapman (Cyprus), H. Etter (FAO) and Refik Erdem, Savni Hus, and Esat Muhlis Oksal (Turkey).

Research Programs

by S. B. Show

U.S. Forest Service (retired) and latterly of the Forestry Division, FAO

The procedure used by the United States Forest Service to ensure that research projects and programs of the Forest Experiment Stations are aimed at major rather than minor or trivial problems of the practitioners' world, is to subject the proposals and plans of the researchers to criticism of administrators.

At least once a year, and more often if need be, a program review board, made up of both groups, spends two or three days in thus dealing with the work of each station. Not only the heads of the research and administrative units, but also their principal staff men are expected to attend and take part in the meetings. It is not enough for, say, forest management people to attend while silvicultural projects are considered and then go back to their work. By staying throughout the discussions, they can hardly avoid forming a solid opinion as to the relative attention paid to their special fields compared with other fields which are competitive in terms of men and money. Thus the usual and beneficial result of the reviews is a reconsideration of the relative attention merited by the several major fields, each of which is, to a degree, competitive with all the others.

Within each field of work, attention centers on the merit, urgency and applicability to real life of projects proposed both by researchers and administrators. The retention in a station's program of fascinating and costly forays into academic investigations is unlikely if the chance of practical application of the results cannot be substantiated. On the other hand, it is a good thing for the researcher to know that his opposite number on the administration is committed to a project, can be reasonably expected to aid in its conduct and will be watching for tangible and useful results in due course.

One common, indeed routine, feature of the annual conferences is to find out what finished work and publication each researcher can report, and particularly whether he has redeemed promises of a year earlier to complete certain jobs. There are always reasons why one more year of study seems essential to the researcher to do a finished piece of work, satisfactory to himself and his vocational colleagues. Administrators are commonly cold to such often subjective wishes.

The process goes a long way towards ensuring that there will be a balance between fundamental research — with no immediately foreseeable application — and work specifically designed for immediate use.

In earlier years, the definition of each project and estimation of the time and money needed was often done quite sketchily, with the result that work expected to be completed in a short time by one man stretched out to require years of work by several men. To circumvent this the practice has grown of defining in advance the scope and particularly the boundaries of each project and its costs. There can be no exact precision in this process, of course, but it does give administrative reviewers a reasonably solid basis on which to judge whether a desirable project will be costly beyond its real importance in the whole scheme of things, so that it had better be postponed. The process also serves to avoid the costly danger of slipping into projects which may grow out of hand and must subsequently either be dropped or sustained by robbing other projects. Perhaps, above all, it gives a basis for appraising the degree of rigidity which a program will have in future years, as more and more long-term projects are accepted and become relatively untouchable. Administrators and researchers alike can be expected to favor some degree of flexibility, so that desirable short-term work may be undertaken promptly.

The give and take of debate in such reviews accomplishes no miracles of perfection. But, within the limits of the means available, it gives a far more useful total program than if program and project selection were the exclusive prerogative of researchers, who — perhaps living in ivory towers insulated from the rough and troubled world of the practitioner — might feel impervious to insistence on results from presumptive users of research.

Above all, the mechanism bespeaks the traditional philosophy that continual fact finding, aimed at solving major problems, is the life-blood of a dynamic organization, and stresses that fact-finder and fact-user alike are members of the same organization.

Reports on the Fourth World Forestry Congress, and on the Latin American meeting of pulp and paper experts held at Buenos Aires in October - November last, will appear in *Unasylva*, Vol. 9, No. 1.

Commodity Report

Forest Products, 1951-1954

Output from the world's forests for the past years has been some 1,420 to 1,470 million cubic meters annually of coniferous and broadleaved roundwood for all uses. About 55 percent of the total volume of roundwood production has been for industrial uses, the rest being fuelwood. Total fellings of coniferous and broadleaved roundwood in 1951, 1952 and 1953, as reported to FAO, are summarized in Table 1.

TABLE 1. – WORLD ROUNDWOOD PRODUCTION
(in million cubic meters round)

Region	1951		1952		1953	
	Total	of which industrial wood	Total	of which industrial wood	Total	of which industrial wood
Europe	266	161	261	160	252	154
U.S.S.R.	335*	190*	365*	205*	400*	230*
Canada and United States	381	310	376	311	376	315
Latin America	171	21	170	21	169	21
Asia	142	51	138	53	142	54
Africa	104	9	104	9	105	10
Pacific Area	22	11	21	11	22	12
WORLD TOTAL	1 421	753	1 435	770	1 466	796

* Estimate.

Changes in the volume of total cut in the world reflect primarily fluctuating production in Europe and North America. There a changing market situation may cause considerable fluctuations in the volume of fellings of the main producing and exporting countries, not at the time when the change in the market takes place but a year or two later. This is the result of the long time lag between actual felling operations and the sale of the final products. Booming market conditions in one year, as for instance in 1951, led to a sizeable rise in the volume of fellings. Later, with a declining market in 1952, the volume of fellings was heavily reduced as industries built up stocks of finished products, drawing largely on their existing supplies of raw materials.

In other regions the situation has been somewhat different. In the U.S.S.R., the program for a steadily increasing volume of fellings is making progress and although little official data are available, there is reason to believe that the fulfilment of the plan has not fallen far behind the set target. In Japan, Asia's largest producer, the need for wood for industrial purposes has led to a steady decline in the production of fuelwood. In Latin America, Africa and the Pacific area, more extensive and better use of forest resources, together with increasing local demand for most forest products, is bringing about a steady, although slow, rise in the level of output.

On the basis of available data there seems to have been a slight rise in world roundwood production in 1953, possibly by some 20 million cubic meters. In North America, favorable economic conditions led to rising production of sawn wood and pulp and paper, and consequently also to larger new supplies of industrial roundwood. In Europe, on the other hand, some decline from the level of 1952 appears to have taken place; production of sawlogs rose only insignificantly and that of pulpwood and pitprops declined, notably in the northern European countries. The decline in European production partly offset the rise in North America and slight rises in other regions.

International trade in roundwood, which had already in 1952 felt the downward trend in the market and had declined from the high level of 1951 by some 3.5 percent, fell rather sharply in 1953 by some further 24 percent. This was due primarily to reduced trade in pitprops and pulpwood in Europe and North America which followed the heavy stock-piling in 1951/52 and unfavorable market conditions for forest products in general in 1952.

TABLE 2. – WORLD EXPORTS OF ROUNDWOOD

Item	1950	1951	1952	1953
	..... *in million cu.m. (r.)*			
Softwood logs	1.46	1.43	1.29	1.20
Hardwood logs	3.15	4.16	3.68	3.90
Pitprops	2.10	2.53	4.60	2.10
Pulpwood	7.23	11.46	9.70	6.40
Poles, posts and pilings	0.54	0.57	0.56	0.70
TOTAL	14.48	20.15	19.83	14.30

Since the end of 1953, the need of industries in Europe to replenish stocks of raw material simultaneously with a strong current demand for most forest products has brought about a moderate increase in fellings in the most important producing countries. Figures for European trade in roundwood during the first half of 1954 also indicated a noticeable rise from the low level of trade in 1953. In North America, on the other hand, the temporary slowing down of demand and rising stocks of sawn wood and pulp products has so far led to a somewhat reduced activity in the forests.

TABLE 3. WORLD PRODUCTION OF SAWN WOOD

Region	1938	1948	1949	1950	1951	1952	1953
				in million cu.m.			
Europe [1]	56.91	53.52	53.86	53.74	53.59	48.97	50.05
U.S.S.R. [2]	34.00	40.00	45.00	49.50	55.00*	60.48	64.00
North America	67.47	103.65	95.95	107.12	105.29	108.41	112.45
Latin America	4.00	8.28	8.57	7.82	9.32	9.56	9.50*
Africa	1.00	1.50	1.70	1.78	2.11	2.28	2.45*
Near East	0.30	0.55	0.37	0.42	0.48	0.54	0.55*
Asia and Far East [3]	18.50	11.68	13.18	16.74	17.48	21.95	22.10*
Oceania	2.50	3.62	3.83	3.98	4.40	4.37	4.45*
WORLD TOTAL	184.70	222.80	222.46	241.10	247.67	256.56	265.55

* Estimate.
[1] Includes estimates for countries in eastern Europe.
[2] Figures officially reported for 1950, 1952, 1953.
[3] Excludes mainland China.

In other regions there seems to be no change from the rather high level of activity that prevailed around the end of 1953; the total cut in the world's forests for 1954 may therefore be expected to show some further rise.

Sawn wood

European and North American production of coniferous and broadleaved sawn wood accounts for some 60 to 65 percent of the total world output of sawn wood. These regions also account for over 90 percent of the world's total exports and about 80 to 85 percent of total imports. In Europe, some 30 to 35 percent of the region's total production of sawn wood enters international trade.

Demand for and consumption of sawn wood are dependent largely on levels of industrial activity and general economic and social conditions, being greatest in those regions where the economic standards are highest, that is, in North America and Europe. So market conditions in these two regions have traditionally set the pattern for the whole world trade in sawn wood. In 1950 to 1952, market trends in North America and Europe differed at times; developments in one region partly balanced those in the other and evened out the general world picture. From the end of 1952 onwards, the "post-Korean" fluctuations in demand and prices stabilized and the general progress of industrial activity and construction in most parts of the world led gradually to more satisfactory market conditions also for sawn wood. World output rose from the 1952 production of 256.56 million cubic meters to 265.55 million cubic meters in 1953, a new record figure. Trade in sawn wood also picked up and was some 27 million cubic meters in 1953 as against 23.5 cubic meters in 1952, remaining however slightly below the record volume of 27.9 million cubic meters in 1951. In Europe, the increased trade was a regional matter; exports to other continents continued to decline. In North America, the strong expansion of industrial activity together with a continuing high level of building resulted in increased output, but the volume of trade between Canada and the United States did not change perceptibly and the decline in exports to Europe was compensated to some extent by larger exports to other continents. In the U.S.S.R., the steady rise of output was used primarily to meet the country's own needs. In Latin America, general economic and trade difficulties hampered the production and trade of sawn wood during the first half of 1953. Towards the end of the year the situation slightly improved, however, and exports by the main producing countries, notably Brazil, to neighboring countries and to other continents showed some increase over 1952. The situation in general, however, remained less satisfactory than in 1951.

In Japan, rapid expansion of the country's industrial production, the heavy backlog of housing requirements and repair, together with steadily growing new housing requirements, put a heavy strain on the Japanese sawmilling industry. Although the output was raised by some 4 percent from the level in 1952 and exports of sawn softwood forbidden, the shortage of sawn wood of all categories was felt increasingly. Payment difficulties made any substantial increase in imports difficult.

While the world market seemed in general favorable, there were some disquieting aspects. The steadying in prices in 1953 had not, at least apparently, succeeded in eliminating the harmful effects of the 1950-52 fluctuations and in restoring the position of sawn wood in the consumer market. In most of the main consuming countries consumption of sawn wood seemed to rise much more slowly from the low levels of 1952 than the rate of industrial activity and even that of house building. Thus, despite the recovery in the volume and trade of sawn wood in 1953, there was no evidence to indicate that there was commensurate increase in actual consumption. Apparent consumption in Europe had fallen from 51.5 million cubic meters in 1950 to 48.5 million cubic meters in 1951 and 47.7 million cubic meters in 1952. In 1953, it recovered only to 48.0 million cubic meters. In North America, also, apparent consumption reached its peak in 1950, at 100.5 million

cubic meters to decline in the two succeeding years to 92.6 and 92.0 million cubic meters. In 1953, it recovered to 96.0 million cubic meters. The 1950 to 1951 fall revealed by the above figures no doubt exaggerates the actual decline since there was some drawing on consumers' stocks. Nevertheless, in general it seems clear that lost consumer markets have not been recaptured. A variety of new substitute materials, most of which seem by now to have become firmly established in the highly industrialized regions, has gradually been replacing sawn wood even in some traditional uses.[1]

While North American and European production of sawn wood appears to be approaching the maximum capacity of the forests to furnish timber, and also of the established sawmilling capacity (in Europe, the sawmilling capacity is far in excess of the available raw material supplies), steady progress is being made in other less developed regions to raise the sawmilling potential. But, even so, progress is lagging planned expansion because of tight capital, and lal and forest extraction costs.

A smooth and steady evolution of demand for sawn wood cannot be expected, because its principal end uses are influenced by very diverse factors. In recent years, demand has been unusually distorted by political climates and actual war. Demand ought to continue to rise, but in all markets, especially in Europe, price is now the decisive factor.

In fact, the development of trade from the end of 1953 until the late summer of 1954 brought about a further increase in export prices of sawn softwood. The sawmill strike on the west coast of the United States led indirectly to British and other European importers continuing their purchases from northern Europe and the U.S.S.R., because of the fear that, owing to the good market for Canadian goods in the United States, insufficient quantities would be available from Canada to Europe. Wholesale and retail prices in most of the importing countries remained, however, fairly stable, and it became increasingly obvious that higher prices paid by importers were difficult to pass on when reselling goods recently bought.

[1] The term "substitutes" is not used in any derogatory sense. A substitute may be wood-based and a more efficient material than solid wood for a particular use. It is substitution of wood by "foreign" materials that is the real danger to primary producers.

TABLE 4. – WORLD TRADE IN SAWN WOOD

Region	1938	1948	1949	1950	1951	1952	1953
				in million cu.m.			
Exports							
Europe [1]	12.00	8.94	10.70	12.77	13.88	10.48	13.24
U.S.S.R. [2]	4.80	0.27	0.62	0.85	0.64	0.60	1.04
North America	6.50	7.28	6.62	10.28	11.02	9.90	9.81
Latin America	–	1.57	1.32	1.82	1.86	1.52	1.36
Africa	–	0.14	0.15	0.19	0.24	0.25	0.30*
Near East		0.03	0.02	0.03	0.04	0.02	0.02
Asia and Far East [3]	–	0.42	0.50	0.66	0.20	0.75	0.80*
Oceania		0.09	0.12	0.09	0.09	0.12	0.11*
WORLD TOTAL		18.74	20.05	26.69	27.97	23.64	26.68
Imports							
Europe [4]	18.00	9.44	11.09	12.33	15.36	12.23	14.83
U.S.S.R. [5]		0.45	0.28	0.01	0.29	0.58	0.33
North America	1.50	4.55	3.92	8.32	6.29	6.27	6.95
Latin America	–	1.27	1.36	1.45	1.87	1.53	1.32*
Africa	–	0.71	0.69	1.26	1.16	1.03	1.04*
Near East	0.50	0.55	0.96	1.08	1.12	0.74	0.1
Asia and Far East [3]	–	0.17	0.23	0.29	0.33	0.46	0.50*
Oceania		0.43	0.64	0.69	1.06	0.72	0.46*
WORLD TOTAL		17.57	19.17	25.43	27.48	23.56	26.44

* Estimate.
[1] Includes exports from eastern European countries to western Europe only, except for 1938.
[2] Exports to western Europe only, except for 1938.
[3] Excludes mainland China.
[4] Includes imports by eastern Europe as reported by exporting countries in western Europe.
[5] Imports as reported by exporting countries in western Europe, except for 1938.

TABLE 5. – WORLD PRODUCTION OF PLYWOOD AND FIBERBOARD

Region	Plywood				Fiberboard			
	1938	1951	1952	1953	1938	1951	1952	1953
	thousand cu.m.				thousand tons			
Europe	1,093	1,675	1,510	1,610	168	900	750	850
Finland	(244)	(314)	(233)	(244)	(23)	(117)	(84)	(104)
Western Germany [1]	(443)	(480)	(419)	(484)	(8)	(106)	(80)	(65)
Italy	(70)	(140)	(140)	(140)	(2)	(37)	(37)	(37)
Sweden	(31)	(57)	(50)	(45)	(93)	(324)	(227)	(270)
Eastern Europe	(270)	(315)*	(320)*	(325)*	(—)	(65)*	(75)*	(85)*
U.S.S.R.	885	810[2]	883	946	3	130*	150*	160*
U.S.A.	575	3,390	4,000	4,500*	600	—	1,193	1,271
Canada	46	344	351	461	42	170	157	177
Japan	200	233	298	408	—	15	13	10
Other regions	50*	340	360	420	—	100	110	130*
WORLD TOTAL	2,850	6,790	7,400	8,345	780	2,467	2,373	2,598

* Estimate.
[1] incl. Eastern Germany in 1938.
[2] Planned figure for 1950.

Plywood and fiberboard

Plywood and fiberboard have ranges of use which considerably overlap. For many purposes they can replace each other; in many end uses they both compete with sawn wood. Since the end of the war there has been a considerable expansion in the output of both these commodities, comparable with that which has taken place in the case of wood pulp. World production of plywood in 1938 (including that of the U.S.S.R.) amounted to about 2.85 million cubic meters; by 1951 it had reached 6.79 million cubic meters and rose to 8.34 million cubic meters in 1953. World output of fiberboards (wallboards or fiber building boards) rose from 780 thousand tons in 1938 to 2.5 million tons in 1951 and 2.6 million tons in 1953; world fiberboard

TABLE 6. – WORLD TRADE IN PLYWOOD AND FIBERBOARD

Region	Plywood				Fiberboard			
	1938	1951	1952	1953	1938	1951	1952	1953
Exports	thousand cu.m.				thousand tons			
Europe	386	400	278	296	22	337	203	237
Finland	(207)	(278)	(221)	215	(—)	(68)	(44)	(44)
Norway	(1)	(1)	(1)	1	(—)	(24)	(17)	(22)
Sweden	(13)	(22)	(12)	15	(22)	(183)	(105)	(127)
Canada and U.S.A.	20	48	54	42	33	43	40	36
U.S.S.R.[1]	234	79	62	49	..	..	..	..
Other regions	..	100	60	90	—	2	2	4
WORLD TOTAL	640	627	450	480	55	382	245	277
Imports								
Europe	470	454	355	294	35	209	130	163
Belgium	(29)	(32)	(24)	(31)		13	14	15
Netherlands	(41)	(40)	(18)	(32)	8	31	26	36
United Kingdom	(272)	(304)	(255)	(147)	27	131	54	67
U.S.A. and Canada	20	47	58	140	20	32	35	37
Other regions	140*	90	70	70	..	40	50	40
WORLD TOTAL	640	591	483	500	55	281	215	240

* Estimate.
[1] To countries in Western Europe only in 1951.

capacity today may be estimated at around 3 million tons.[2]

Like all other forest products, consumption of these commodities was affected by the events of 1950 to 1952. International trade declined particularly sharply, and was slow to recover; not until mid-1953 was any substantial improvement noted. However, neither for plywood nor for fiberboard were the price fluctuations recorded in 1951 and 1952 as violent as those which occurred in the rest of the forest products field. An explanation may be found in the fact that, as demand began to revive and consumer stocks began to need replenishing, expanded domestic capacity absorbed the first wave of new orders. Not until consumption had made a substantial recovery was it necessary for buyers to look for additional foreign supplies. As the main producing countries intend a very substantial part of total production for export, they had to wait much longer than exporters of sawn wood, pulp and paper to share in the restored stability which in general characterized 1953.

Whereas most forest products prices strengthened in the course of 1953, registering advances of 5 to 10 percent during the year, plywood and fiberboard prices remained steady, and even by the late spring of 1954 only fractional increases had been recorded. With continuously favorable market conditions, the volume of international trade began to show a noticeable increase from the level in 1953; and by the autumn of 1954 even prices had shown some further strengthening, although the rise was still inferior to that of sawn wood prices.

World plywood and fiberboard capacity continues to expand. In both commodities technical progress is diversifying the product and rapidly extending the range of end uses. The future holds great possibilities for both, but especially for fiberboard (and chipboard) for which the raw material requirements need not be exacting while the establishment of a mill of economic size does not call for investment on a prohibitive scale. In the long run, therefore, it seems probable that world trade in these commodities, though it may well increase beyond the present level, will inevitably become less and less important in relation to total world output. A corollary of this is that plywood and fiberboard industries that are primarily geared towards export markets will become increasingly vulnerable.

Wood pulp and pulp products

The year 1952 had been marked by a serious recession in the world pulp and paper trade. Very early in the year consumers began to react sharply to the unprecedented price rises of 1951. The impact on output and trade was all the more intense since consumer stocks had been built up during the boom and the turn of the year brought a check, and in many cases a setback, in industrial activity. There was a real fall in consumption; buying was curtailed even more sharply and, in spite of the consequent price fall, the pulp and pulp products market remained stagnant during most of 1952. Board and wrapping grades of paper, used in almost every sector of the economy, were particularly affected. Newsprint alone was exempt from these market vicissitudes. The demand for newsprint remained at a high level and output continued to rise during 1952.

All regions shared in the market fluctuations of 1950 to 1952, but it was in Europe, which is the most important pulp and pulp products exporting region and where general economic activity slackened most, that they were most intense. As mill stocks accumulated in the main producing, and especially the exporting, countries produc-

TABLE 7. – WORLD PRODUCTION OF WOOD I

Region	1938	1950	1951	1952	
	thousand tons				
Europe (western)	10 614[1]	8 530	9 430	8 480	9 050
Finland, Norway, Sweden	(6 071)	(6 087)	(6 647)	(5 917)	(6 223)
Europe(eastern)	—	1 150*	1 250*	1 300*	1 350*
U.S.S.R.	1 163	1 600*	1 800*	2 000*	2 100*
U.S.A.	5 384	13 471	14 964	14 070	14 840
Canada	3 254	7 462	8 152	7 890	7 930
Latin America	25	300	310	340	400*
Asia	930	725	1 080	1 270	1 540
Oceania	—	154	154	220	230
WORLD TOTAL	21 370	33 390	37 140	35 570	37 440

* Estimate.
[1] Including eastern Europe.

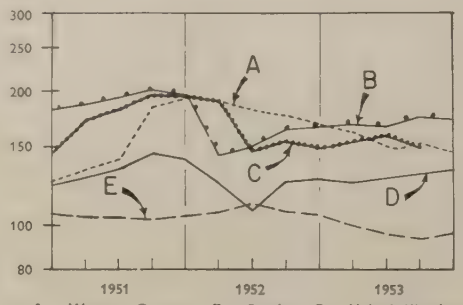
TABLE 8. – WORLD TRADE IN WOOD PULP

Region	1938	1950	1951	1952	1953
Exports	thousand tons				
Europe	4 083	3 910	3 950	3 190	3 990
Finland, Norway, Sweden	(3 738)	(3 701)	(3 763)	(3 029)	(3 764)
Canada	500	1 662	2 021	1 751	1 763
WORLD TOTAL	4 700*	5 660	6 180	5 130	5 900
Imports					
Europe	3 008	2 973	3 236	2 708	3 101
U.S.A.	1 550	2 164	2 145	1 756	1 958
Latin America	—	317	329	260	201
WORLD TOTAL	4 700*	5 530	5 880	4 930	5 500

* Estimate.

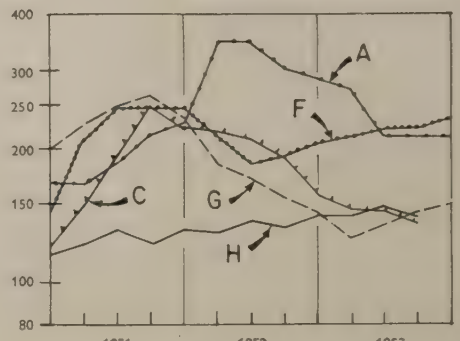
[2] A commodity report on *Fiberboards* in the March 1954 issue of *Unasylva* described production as beginning in the U.S.A. in the early 1920's. By this was meant large-scale commercial production. In a letter to *Unasylva*, a Director of the Sundeala Board Company Ltd., London, England, points out that his company produced in 1898 the first fiber building-board to be manufactured on a commercial scale in any part of the world: "*Agasote*, the original board, was a hard-board and in the first week of manufacture we produced 10 tons which in those days and as a pioneer effort, was an extremely good feat."

SAWN WOOD



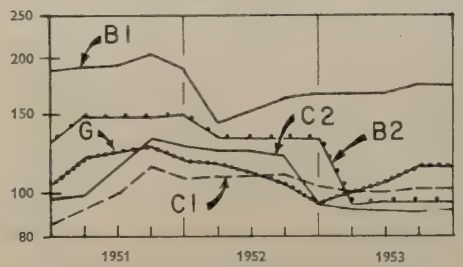
A - Western Germany. B - Sweden. C - United Kingdom. D - Belgium. E - United States of America.

ROUNDWOOD



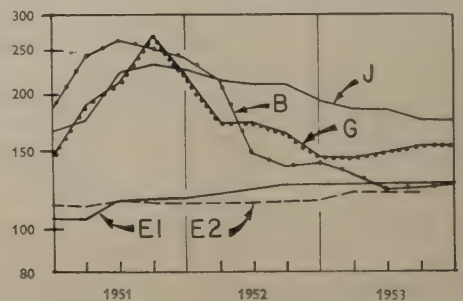
A - Western Germany. C - United Kingdom. F - Austria. G - Finland. H - Switzerland.

PLYWOOD - WALLBOARD



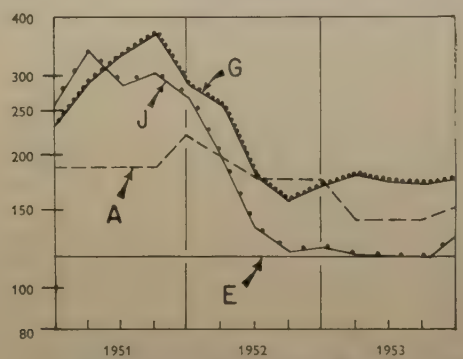
B1 - Sweden 1. B2 - Sweden 2. C1 - United Kingdom 1. C2 - United Kingdom 2. G - Finland.

PAPER



B - Sweden. E1 - U.S.A.1. E2 - U.S.A.2. G - Finland. J - France.

WOOD PULP



A - Western Germany. E - United States of America G - Finland. J - France.

NOTES :

Sawn wood

Belgium : imported : Sweden : f.o.b. ; U.K. : c.i.f. : U.S.A. : domestic; W. Germany : domestic.

Roundwood

U.K. : pitprops, c.i.f. : W. Germany : pitprops, domestic Finland : pulpwood, f.o.b. ; Austria : sawlogs, domestic. Switzerland : sawlogs domestic.

Plywood-Wallboard

Sweden 1. Sawn softwood, f.o.b. 2½" - 7" u/s battens. Finland birch plywood, f.o.b. ; U.K. 1 Finnish birch plywood, c.i.f. ; U.K. : Other plywood, c.i.f. ; Sweden 2 wallboard 1/8" hard, f.o.b.

Wood Pulp

U.S. : domestic ; Sweden bleached sulphite f.o.b. ; France bleached sulphite, c.i.f. Rouen W. Germany Bavaria, unbleached sulphite ; station of destination.

Paper

Finland : Newsprint, f.o.b. ; U.S.1 newsprint, France : newsprint, 1 l. 50.52 gr. excluding taxes station of departure. Sweden. Kraft, f.o.b. ; U.S.2 printing.

Table 9. – World Production of Newsprint

Region	1938	1950	1951	1952	1953
	thousand tons				
Europe	2 801	2 570	2 650	2 670	2 825
Finland, Sweden, Norway	(819)	(910)	(910)	(927)	(948)
United Kingdom	(813)	(553)	(535)	(546)	(613)
Eastern Europe	—	(290)*	(315)*	(330)*	(360)*
Canada	2 625	4 825	5 045	5 177	5 190
U.S.A.	755	919	1 006	1 006	966
Latin America	—	50	50	50	60*
Asia [1]	200*	185	220	340	491
Oceania	—	30	30	33	46
U.S.S.R.	227	360*	400*	425*	450*
World Total	6 600*	8 935	9 400	9 700	10 030

* Estimates.
[1] Incl. estimates for China: 45 in 1950, 50 in 1951, 60 in 1952 and 70 in 1953.

tion was curtailed. Many mills closed down temporarily; others went over to short-time working.

As the year 1952 advanced, the demand for pulp products rose, and pulp and paper mills began to resume operations on a normal scale.

The year 1953 opened on a note of renewed, if still cautious, optimism. By the spring, production was back to a high level in most countries and had reached record levels in some. There were some exceptions, notably Finland, where there remained the problem of adjusting internal costs to the now stabilized level of world prices. The favorable development continued also in 1954 and led to a marked increase in the volume of output and trade. With general economic conditions continuing favorable, the year may prove to be one of a reasonably high level of activity, at fairly stable prices, for the world market in pulp and its products.

World pulp production rose from 35.6 million tons in 1952 to 37.4 million tons in 1953, thus exceeding the record 1951 figure by 300,000 tons. U.S. expansion accounted for most of the increase, but there were substantial advances also in Japan, Canada and several European countries. World trade in pulp also expanded, by about 700 thousand tons, though the total volume fell slightly short of the record 1951 figure. It may be noted, however, that exports from the three northern European countries, which together account for over three-fifths of the world total, were almost exactly back to the 1951 peak volume.

Production and trade in these countries continued to thrive in the early months of 1954. Optimism seems to pervade the North American market, where in the world, the rapid expansion of Japanese capacity continues, while slow but steady progress is being made in raising domestic capacity in the less developed areas of the world, especially in Latin America. Several new mills are expected to come into operation during the next two years, while many are under discussion.[3]

The recovery in 1953 was reflected also in improved output and trade in paper and paperboard. World newsprint production rose from 9.7 million tons in 1952 to 10.0 million tons in 1953; in 1951, output had totalled 9.4 million tons. Production of other categories of paper increased sharply from the low 1952 level, while failing to regain the record 1951 level; paperboard output, however, registered the biggest advance, reaching a new record level in 1953, the most notable increase being that recorded in the United States. Though paperboard production declined slightly in the early months of 1954, it seems probable that the volume of world output of all categories of paper and paperboard, taken together, will in 1954 exceed that of any previous year.

World newsprint exports in 1953 totalled 5.92 million tons against 5.85 million tons in the previous year. Other paper and paperboard exports rose by 0.30 million tons to 2.14 million tons; this was, however, well below the 1951 volume, 2.43 million tons. The market continued satisfactory through the spring months of 1954. Though the rate of influx of new orders slackened, paper mills in most countries continued to operate at near capacity to cope with outstanding orders. In North America, the world's largest consumer of paper and paperboard, demand is expected to remain firm in 1954. Capacity is continuing to rise; since 1949 paper, paperboard and wood pulp capacity in the United States have increased by 13, 26 and 39 percent respectively. Much of this capacity was, of course, planned in 1950 and 1951, when boom conditions prevailed, and it would seem that expansion has run somewhat ahead of domestic demand. How far excess capacity can be applied to satisfying the rising needs of wood- and pulp-deficit-regions will depend on the latter's capacity to pay for dollar imports.

Thus the long-term upward trend in world demand for pulp products seems to have reasserted itself in 1953. This trend, the dominant one in the field of forest products since the war, is certain to continue, though the possibility of temporary interruptions will remain. The danger is any serious disparity between the rate at which new capacity is being created and the rate at which effective demand can be made to rise.

[3] Possibilities for expanding production in Latin America were discussed at a meeting of pulp and paper experts in Buenos Aires in October, sponsored jointly by FAO, the Economic Commission for Latin America, and the United Nations Technical Assistance Administration.

Third Conference on Wood Technology

FAO has among its advisory technical panels two in the field of forest products — one dealing with wood chemistry and the other with mechanical wood technology. The purpose of these panels of individual experts is very broadly to aid the Organization in making the forest products supplies of the world go further and serve mankind better. More specifically in the case of the technical panel on mechanical wood technology, the purpose is to promote, in the engineering and mechanical fields, the interchange of technical information and research findings, the unification as far as practicable of research methods, and the development of improved practices relating to the utilization of the forest crop.

The technical panel on mechanical wood technology represents in effect an international body of engineers, technologists and other scientists specializing in forest products research and mechanical phases of forest products utilization. It was established by the Director-General of FAO in consultation with Member Governments to advise the Organization on specific problems on which international exchange of information and international agreement are highly desirable. Such problems include the evaluation of the physical and mechanical properties of the various species of wood, including tropical woods; the evaluation of the properties of veneer, plywood, fiberboard; modified wood, and other wood and wood-base products; and the standardization, insofar as possible, of test methods. A partial list of other subjects is as follows:

mechanical conversion methods and equipment,
nomenclature and definitions,
methods of sampling and analysis,
principles of structural timber grading,
working stresses for timber designs,
methods of seasoning and conditioning materials,
methods of preservative treatment and their effect on strength,
building construction,
joints and fastenings,
glued laminated construction,
industrial and factory uses,
requirements for such uses as poles, ties (sleepers), and mine timbers (pitprops).

In the early days of FAO, meetings of a technical panel (at that time called a committee) on mechanical wood technology were organized at Zurich (Switzerland) and Washington (U.S.A.) in 1947. A further meeting at Geneva (Switzerland) in 1948 made considerable progress in agreements on methods of testing wood. Since the technical panel, as such, was without authority to make recommendations to governments in regard to such agreements, it then appeared advisable to change the status of the FAO meetings on mechanical wood technology so that there might be such authority. This was made possible by inviting Member Governments to delegate representatives to special conferences irrespective of their membership of the technical panel on mechanical wood technology.

Accordingly, in 1949, the Director-General of FAO invited all Member Governments to send delegates to a First Conference on Mechanical Wood Technology at Geneva (Switzerland). A second conference of this nature was convened at Igls (Austria) in 1951, and a Third Conference on Wood Technology at Paris (France) 17 to 26 May, 1954. In the intervening periods, working parties of members of the technical panel on mechanical wood technology carried out special assignments allotted by the Conferences and then reported back the results of their work.

At the Third Conference, there were 54 participants from 26 member countries, as follows: Austria, Belgium, Burma, Canada, Costa Rica, Dominican Republic, Finland, France, Germany, Iraq, Iran, Italy, Japan, Korea, the Netherlands, Norway, Pakistan, Philippines, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States of America and Viet-Nam.

The Conference was formally opened on 17 May at the Chambre de Commerce Internationale by Mr. Leloup on behalf of the Director-General of FAO. He recalled the work carried out at previous Conferences and by various working parties in the intervening periods, and outlined the scope of the deliberations of the present session. Speaking on behalf of the French Government, Mr. J. de Vaissière (Direction des Eaux et Forêts) welcomed the delegates and stressed that their conclusions and recommendations would hold great interest for all those who were concerned with sustaining the popularity and competitive status on world markets of wood and wood-base materials.

At the final plenary meeting on 26 May the Conference was addressed by Mr. du Vignaux, Inspecteur-Général des Eaux et Forêts. On that occasion the delegates formally expressed their deep appreciation to the French Government for the generous hospitality and facilities accorded to the Conference at Paris. In particular, they acknowledged with sincere thanks the special contributions made by the Directors of the Centre Technique du Bois, the Director of the Centre Technique Forestier Tropical, and the members of their staffs.

The Conference unanimously elected J. Campredon (France) as its Chairman. L. J. Markwardt (U.S.A.) and B. Thunell (Sweden) were elected Vice-Chairmen.

Technical discussions dealt with the following:

1. Testing methods — review of past FAO Conferences and proposals for further internationally acceptable methods relating to:
   (*a*) timber,
   (*b*) fiberboards, including chipboards,
   (*c*) veneer, plywood and other glued veneer constructions;
2. strength and stress grading of timber;
3. methods of testing the resistance of treated and untreated wood and wood-base materials against fire;
4. advances and developments in sawing and machining techniques;
5. progress in producing new construction materials based on wood;
6. promotion of the international exchange of ideas and information among research workers.

The following working parties were established under the Chairmen indicated:

1. Testing of Mechanical Properties of Timber.
   (*H. Kuhne*, Switzerland);
2. Testing of Physical Properties of Timber.
   (*F.F.P. Kollmann*, Germany);
3. Testing Methods for Fiberboards and Chipboards.
   (*L. J. Markwardt*, U.S.A.);
4. Testing Methods for Veneer, Plywood and other glued Veneer Constructions.
   (*F. H. Armstrong*, U.K.);
5. Structural Grading.
   (*B. Thunell*, Sweden);
6. Fire Test Methods for Wood and Wood-base Materials.
   (*O. Brauns*, Sweden);
7. Sawing and Machining.
   (*B. Thunell*, Sweden);
8. Classification of Wood-base Materials.
   (*F.F.P. Kollmann*, Germany).

The report of the Third Conference is available from FAO.

FAO/ECE Joint Working Party on Logging Techniques and Training of Forest Workers

Forestry work is one of the most arduous and exacting occupations pursued under the most diverse climatic conditions, and often with casual, unskilled or seasonal labor. In many cases it is carried out with implements which have scarcely changed during two to three hundred years. Not only does output tend to remain low, but the status of the workers is also affected, wages being poor and recruitment difficult.

In a mechanized age, forest industries in many regions are out of step. Therefore the evolution of improved working techniques which may lighten the work and improve performance, while at the same time lowering costs, is of great importance. Such a development can only go hand-in-hand with the formation of a skilled labor force enjoying good wages and satisfactory working conditions.

Some of the many problems involved in the improvement of forestry working techniques were discussed last June at Geneva by specialists who attended a technical meeting called jointly by FAO and the United Nations Economic Commission for Europe. This meeting grew out of the work which had already been carried out by an eight-member Pilot Committee established by FAO's European Forestry Commission in 1952. (See *Unasylva* Vol. VII, No. 2).

Experts from Austria, Czechoslovakia, Denmark, Finland, France, Eastern and Western Germany, Italy, Netherlands, Norway, Poland, Sweden, Switzerland, United Kingdom, U.S.S.R. and Yugoslavia participated in the meeting, which was also attended by a representative from the International Labour Organisation, an observer from Burma and technical advisors from Canada and the United States. H. Winkelman (Switzerland) was elected chairman.

Working methods and techniques

After a discussion of a study on international comparison of performance tests in logging by H. Hilf (German Federal Republic), it was recommended that performance comparisons in Europe should be carried out for both high forests and coppice and in groups of countries having similar conditions of climate, species, etc. The meeting also decided to have a study made of work that can be carried out by one man (including work involving the use of mechanized equipment). It stressed the need to facilitate the exchange of experts between different countries for the purpose of studying new working methods. A study on criteria for correct logging techniques and best methods of work in European countries by H. Gläser (German Federal Republic) was approved; countries should pay more attention to integration between research and practical work.

The meeting approved the organization of a training course for timekeepers at Zürich under the auspices of the Swiss Federal Institute for Forest Research. This course, the second of its kind, was held in July and was attended by 22 students from nine European countries.

Mechanization

Having reviewed reports that had been prepared on power saws, loading and tractors, the meeting decided to collect and distribute further information on research and new documentation. A working party was set up to consider standardizing of tractor testing (in which the International Standards Organization was also interested) and methods of calculating operation costs of forest tractors. New projects proposed included investigations on chemical and mechanical barking, full-tree logging, the bundling of small-sized timber, and the handling and transport of timber in mountainous country.

Forest workers' training

Delegates stressed the need for the training of instructors for forest workers. It was proposed that the International Labour Organisation, which had collaborated with the original Pilot Committee on vocational training, should sponsor traveling scholarships and provide experts for the guidance of officials in charge of forest workers' training. Procedures for the exchange of teaching material, films, slides, etc., were planned. The problem of the health and safety of forest workers was discussed and it was decided to carry out, in collaboration with ILO, an international study on this important question.

The meeting approved the work which had been carried out on a directory of research and training institutes and on documentation and bibliography. The need for a multilingual glossary on forest work science would be examined in collaboration with the International Union of Forest Research Organizations (IUFRO) and the Joint FAO/IUFRO Committee on Bibliography.

Study tour

A study tour was organized by the Italian Government, during which delegates visited the Testing Station of the Centro Nazionale Meccanico Agricolo at Turin, where equipment for the testing of tractors was inspected and some trial testing carried out. Near Piacenza mechanized logging and planting operations were inspected, and the extraction of timber by cableway in mountainous country seen at Domodossola.

Publications

The following studies in the field of forestry working technique and vocational training have been published:

1. FAO Staff - *European Directory of Research and Training Institutes Concerned with the Rationalization of Forestry Work in the Field of Felling, Logging and Transport of Timber.* (FAO/EFC/LOG/14 Rev. 1).

2. Glaser, H. - *Bibliography on Work Science in Forests.* (MEFAO/3/54).

3. _____. - *Criteria for Correct Logging Techniques and Best Methods of Work in European Countries.* (FAO/EFC/LOG/23, TIM/LOG/2).

4. Hilf, H. H. - *International Performance Comparison in the Field of Logging.* (FAO/EFC/LOG/31).

5. ILO Staff. - *The Vocational Training of Forestry Workers.* (FAO/EFC/LOG/15, Rev. 1).

6. Kantola, M. - *Loading of Coniferous Sawlogs on Trucks.* (FAO/EFC/LOG/20).

7. de Megille, X. - *Tractors for Logging.* (FAO Forestry Development Paper No. 1).

8. _____. - *Forestry Criteria and Equipment of Tractors.* (FAO/EFC/LOG/28).

9. Sundberg, U. - *Use of Power Saws in Forestry Operations.* (FAO/EFC/LOG/19).

Technical Assistance Notes

To-date, over 100 forestry reports to governments have been issued by FAO. These are confidential documents which are not available for distribution except on the express authority of the government concerned.

Formal reports to governments after the completion of missions are not, of course, in most cases the really valuable part of technical assistance. They often represent only a summary rendering of an expert's findings and recommendations, and do not supplant in value the expert's on-the-spot advice, training and leadership.

Technical assistance continues to represent the action arm of FAO's work in forestry. But requests for missions still greatly exceed the financial capacity of the program.

India. Except for one expert working on problems of desert control, all technical assistance assignments in India have been concerned with various phases of utilization — sawmilling, wood technology research, mountain logging, improvement of the plywood industry, and timber engineering. A survey of the technical and economic aspects of the pulp and paper industry and the raw material possibilities concluded with recommendations for a two-phased program: short-term developments covering five to six years and aiming at an increase in capacity of 45,000 tons, and a long-term program covering 15 to 20 years, which might serve to meet the entire paper demand of the country.

★

Philippines. *A team of FAO and United Nations experts have been investigating the prospects for expansion of the pulp and paper industry in the Philippines. The preliminary surveys have now been brought to a conclusion, and estimates of capital cost, operating cost and return on investment arrived at. The domestic market is sufficient to absorb some* 30,000 *tons per year of new production of a range of papers and paperboards, plus about* 1,400 *tons of lightweight papers, as well as an increased production of miscellaneous papers from the existing paper mills. The most promising raw materials are sugar-cane bagasse in Negros Occidental, rain-forest wood and wood wastes on the island of Mindanao, and abaca plantation waste near Davao. The possibility of obtaining native long-fibered, low cost raw materials in quantity in the near future is remote, but the prospects of growing pine or other conifers to ensure a supply in the more distant future are good. The photograph shows a typical stand of Benguet pine* (Pinus insularis) *in the mountain province of Luzon, a possible future source of pulpwood.*

Iraq. *Experts have advised on the planting of eucalypt species and on poplar cultivation. There are two main aspects of the poplar problem in Iraq: first, improvement in present yield, and second, increase in area grown, to be considered before turning to a third — the introduction and propagation of exotic species. Poplars have been grown in the north of Iraq for centuries. The photograph on the right shows a grove around a homestead in the otherwise barren countryside of Cham Koshkot. Considerable patience and skill are needed to persuade landowners to modify and improve their cultivation techniques.*

★

Yugoslavia. A considerable number of forestry experts have been at work on short assignments, and many Yugoslav technicians have been studying abroad on FAO Fellowships. Advice and assistance have been given in the fields of forest policy; soil conservation; genetics; reforestation; silviculture; forest products research; mountain logging; veneer and plywood manufacture; bandsaws; kiln drying; and utilization of wood waste. Tremendous sacrifices were demanded from the forests of Yugoslavia through two world wars, and again for the rehabilitation of the country afterwards. The forests have been drawn on, in some cases to the point of exhaustion, to re-build thousands of homesteads, bridges and railways, and for large exports of timber to secure foreign monies so much needed for the industrial development of the country. Today, with the period of greatest demand over, Yugoslav foresters face the difficult task of reconstituting their forest resources and introducing sound management.

★

Honduras. *In the photograph above, a forester shows the right swing of the scraper during demonstrations of correct methods of pine tapping. As part of a drive to correct the usual destructive resin-tapping, demonstrations have been widely organized, some being attended by over* 60 campesinos *at a time. First the villagers are shown the proper equipment and told how it should be used. Practical demonstrations are given and then the* campesinos *try the method themselves.*

★

Austria. *Between 1951 and 1953, eight specialists carried out short-term assignments in Austria, assisting in the reactivation of forestry and forest industries, and the establishment of new forest research and forest products research institutes. One assignment of longer duration was concerned in part with providing professional liaison between the Government and the United States Mission of Economic Co-operation, and secondly with advising on reforestation, particularly faster and more economical methods of planting, including the introduction of a certain degree of mechanization of operations. A series of training courses for forest workers, students completing their technical training, and other groups, and a number of demonstration courses of various forestry operations intended mainly for small woodland owners, were initiated and are being continued. The conclusion of this assignment also marks the completion of FAO's technical assistance work in Austria in the field of forestry. The accompanying photograph shows the kind of war-damaged area, caused by the explosion of ammunition dumps, still needing reforestation.*

Protection from Avalanches

The Swiss Government was host to 23 experts from Austria, France, Germany, Italy, Norway, Spain, Switzerland and Yugoslavia who participated, together with observers from the International Red Cross Association, in a study tour in the Alps from 27 June to 7 July 1954.

The primary purpose of this tour was to examine the measures taken in Switzerland for protection from avalanches. Organized by the Swiss Federal Inspection of Forests, Hunting and Fishing, it started at Davos where is established the Federal Institute for the Study of Snow and Avalanches, under the leadership of Dr. M. de Quervain. At the Institute's Headquarters, he and his collaborators first explained the present stage of development in anti-avalanche measures. Afterwards a visit was made to the laboratories and experimental fields at Weissfluhjoch, situated above the village at an altitude of 2,668 meters.

The metamorphosis of the snow and its behavior under varying conditions of stress, strain and temperature are studied in the cool-chambers of the laboratory and under natural conditions in the field, and the findings of this research are used in devising and building various types of structures designed to influence the snow mass and to create conditions unfavorable to the development of an avalanche. Conditions and methods are also studied for optimum safe release of avalanches by artificial means; advice and assistance is given to cantonal and communal authorities in their local avalanche problems; and regular meteorological bulletins and avalanche-danger warnings are issued.

During the rest of the tour, the experts were able to examine the practical effects of protection works set up to arrest, break up or deviate avalanches. These are essentially of two kinds:

(*a*) temporary, below the upper tree limit, and usually combined with tree planting programs to afford protection to villages, communications, and to the young trees themselves until such time as they have grown sufficiently strong to form a barrier to the passage or the starting of avalanches;

(*b*) permanent structures of a wide range of types and material built above the tree-limit or where afforestation is impossible.

In some localities, the evolution of anti-avalanche structures could be examined, from the first terraces and remains of old dry-stone walling to the most modern types of snow-rakes and fences made of steel cable, aluminium or pre-stressed concrete. Industry is collaborating in the research, manufacture and experimental work being carried out to discover the most suitable type of material and design for these structures, and for their foundations.

Members of the tour went first from Davos to Pontresina and the Schafberg zone which protects the village. The importance of well-established protective forest stands was constantly stressed. (In Austria, for example, despite a generally low upper tree-limit, it has been determined that three-fifths of all avalanches have their origin below that elevation, and therefore within the zone where forest can be established). Great care is given in Switzerland to ecological evidence at the upper tree-limit to help determine the best species to be used in planting, and whether preliminary plantings of other vegetation are necessary to create favorable soil conditions and microclimates. Everything is done to raise as far as possible the local upper tree-limit in all potentially dangerous areas.

In some cases the establishment of a road in connection with a protection project is either too difficult, too costly, or too slow for the urgency of the situation, and aerial ropeway systems must be used. But, in general, it is felt that roads should be given preference over cable transport since they also represent enhanced facilities for control and improve-

Pre-stressed concrete snow-rake, with protective earth covering against falling rocks.
By courtesy of Vobag, Switzerland.

Check-trestle made of pre-stressed concrete.
By courtesy of Vobag, Switzerland.

Light metal snow-rake.
By courtesy of Rorschach, Switzerland.

ment of pasture, forest management, tourism, ease of access for supplies to mountain populations and for the transport to market of dairy produce.

From Pontresina the tour continued over the Julia Pass and past the Marmorera hydroelectric project, the largest earth dam of its kind in Europe. Here a law dating back to 1902 is enforced whereby compensatory afforestation must be carried out for any forest area cleared for other purposes.

Continuing to Sedrun, the deviation walls and triangular concrete breaking-trestles of the Platta-Baselgia area were visited. The latter are an alternative form of obstacle to the Austrian flattened conical arresting-mounds, and do less damage to the pastures by disturbing only a minimum of soil and its associated vegetation.

The next stage of the tour was to Andermatt in the Canton of Uri, over the Oberalp-pass. At the Santa-Brida (Tavetsch) and the Kirchberg protection projects, visited on the way, a new and interesting type of linked-triangular cable-netting was being tried out, with the collaboration of industrial interests.

From Andermatt, before turning west into the Cantons of Bern and Valais, the par[illegible] Vallascia project [illegible] Pass above Airol[illegible] Tessin, where a num[illegible] of structure in alumini[illegible] ed concrete, and a comb[illegible] these with wood and metal [illegible] were seen.

In the Valais, excursions were made along the Rhône and the Saas val[illegible] where, among other items of inter[illegible], were the concrete open-faced tun[illegible] under construction for the protect[illegible] of parts of a recently opened m[illegible] road. Once again projects were visited where industry and public services are collaborating in research to ascertain the best types of structure, materials, foundations and spacing for different conditions of topography and soil.

The tour ended with a business meeting at which the participants agreed on a number of recommendations to governments relating to problems of torrent-control and protection from avalanches. Subjects discussed included first-aid measures, insurance, the creation of special services to warn against avalanche danger, and the need for standard annual records for the international exchange of information.

Joint Subcommission on Mediterranean Forestry Problems

'Silva Mediterranea'

The alternative title of *Silva Mediterranea* was adopted for the Joint Subcommission on Mediterranean Forestry Problems by the fourth session held at Athens, 1 to 5 June. In this way it was possible to make a link in continuity with the pre-war Mediterranean association of foresters known by that title, and for recognition to be given to the importance of the work carried out by that body.

The Mediterranean Subcommission organized by FAO was originally a subsidiary body of the European Forestry Commission but is now a joint enterprise of this Commission and the Near East Forestry Commission. It is hoped to extend its field of action to all countries and areas having a Mediterranean-type climate.

Representatives of France (Metropolitan, Morocco, Tunisia), Greece, Israel, Italy, Portugal, Spain, Turkey, United Kingdom (Cyprus) and Yugoslavia attended the session in Greece, and re-elected A. Pavari (Italy) as Chairman, with E. Gonzales Vazquez (Spain) and L. Markovic (Yugoslavia) as Vice-Chairmen. A study tour was arranged after the session to forest areas in the neighborhood of Corinthos, Patrai, Pyrgos, Amfissa, Lamia, Larissa, Trikala, Volos and Levadhia. The excellent arrangements for this tour by the Greek Forest Service enabled interesting on-the-spot discussions to be held on pine-tapping, torrent control, afforestation, use of eucalypts, land utilization, forest grazing, forest management, logging methods and construction of forest roads.

Delegates reported on their experience with planting eucalypts in the various countries of the Mediterranean basin. It was agreed that studies should be undertaken on planting and tending techniques and on adapting various species of eucalypts to habitats with particularly cold winters or dry summers, to calcareous soils, to salty lands and to very clayey soils. A special study tour was arranged for Morocco in October, and the meeting hoped that regional working parties to be concerned with eucalypts could be created within the FAO Latin American and Asia-Pacific Forestry Commissions. The idea was mooted of another tour in Australia, on the lines of the successful project organized in 1952.

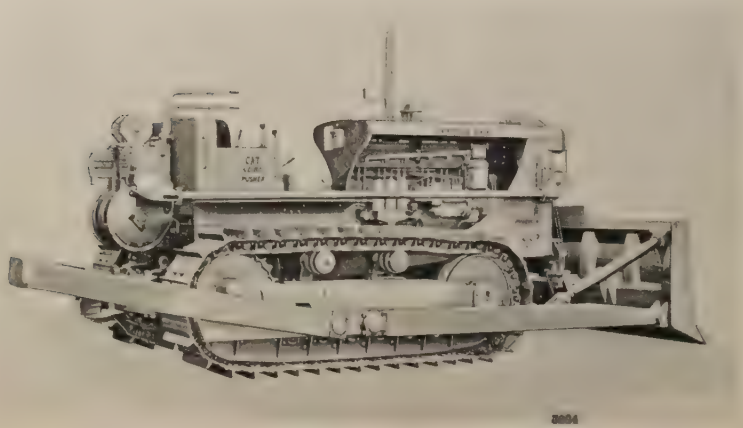
In regard to afforestation techniques generally, it was decided after discussion to set up a permanent working party to study problems in arid areas in collaboration with the International Union of Forest Research Organizations.[1]

During the course of the session of the Subcommission, the permanent Working Party on Cork Oak held several meetings, under the chairmanship of J. V. Natividada (Portugal). It considered that the present economic situation was favorable to an expansion of cork oak cultivation. As a great part of the area to be consigned to cultivation of cork oak would be either natural grazing grounds with at present no, or very little, tree growth, or very rough land where soil conservation was of paramount importance, it was suggested that all countries concerned should closely follow the studies on Mediterranean land-use problems being undertaken by the Subcommission.

[1] The new FAO regional forestry officer for the Near East, J. Moser, has lately had considerable experience of this type of work in Libya. Mr. Moser, is replacing Mr. S. A. Vahid, who has had to resign his appointment owing to ill-health.

Equipment News

Interest in the development of forest utilization and woodworking industries is reflected in the continual demand for information on new equipment. FAO's Forestry Division collects such information and passes it, on request, to Member Governments: a selection is published here. FAO accepts no responsibility for ther claims of manufacturers.

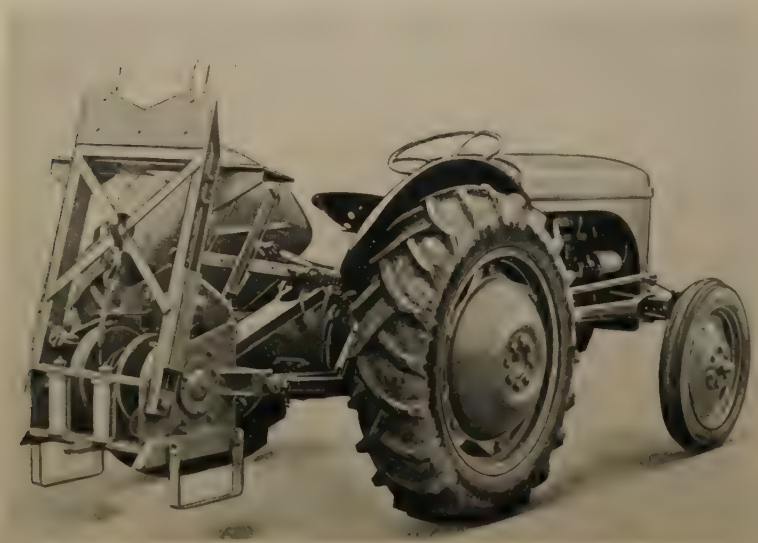


D8 Pusher Tractor. — A modified version of the D8 tractor adapted to and specifically equipped for pusher loading work has been developed to allow the heap loading of large scrapers. *Specifications*: D1 3000 engine has been modified to produce 150 drawbar-horse-power at 1200 r.p.m.; weight increased to 50,000 lb. (23,000 kg.) for better pusher balance and increased traction and includes as standard equipment a special heavy weight crankcase guard and track roller guards; bulldozer and cable controls for inline pushing action and clean up of cut; new transmission for the most suitable pushing speed and oil-type clutches; tandem pusher frame attachment permitting the transfer of power from one tractor to another through the track roller frame thus avoiding the highly destructive stresses imposed on the leading tractor's final drive.

Caterpillar Tractor Co., Peoria 8, Illinois, U.S.A.

Nova Log Cart. — This cart, made in two models, for loads of 3 and 5 tons, is suitable for both horse and tractor drive; when used with a tractor the hydraulic pump will lift the logs by means of a connection to the log cart. When draft animals are used, logs are raised by hand pump (see square box on rack of cart). *Specifications*: 3 ton model, inner width of cart 90 cm. to take logs of up to 80 cm. in thickness; 5 ton model, inner width of cart 115 cm., for logs of up to 1 m. in thickness.

Ivar Mikkelsen, Kronprinsensvej 27, Copenhagen, Denmark.



Ferguson Winch. — This winch, for attachment to a tractor, has a positive drive by universal jointed shaft through a totally enclosed oil bath lubricated worm and worm-wheel to the cable drum. *Specifications*: pull: 7000 lb. (3,200 kg.); mounting: rear mounted by three point linkage; drive: by power take off; clutch: by hand lever; rope speed: 50 ft. (15 m.) per minute at 1500 engine r.p.m., standard rope 40 ft. (12 m.) with 100 ft. (30 m.) capacity. *Dimensions*: height: 55 in. (140 cm.); length: 48 in. (122 cm.); width: 32 in. (81 cm.); weight: approx. 670 lb. (300 kg.).

Massey-Harris Ferguson Ltd., Coventry, England.

SICOMETRE. — Measuring instrument with a metal ribbon 2 meters long and an automatic reckoner which registers the number of lengths measured. The two operations can be done with one hand. *Specifications*: diameter 45 mm., weight, 175 grams.

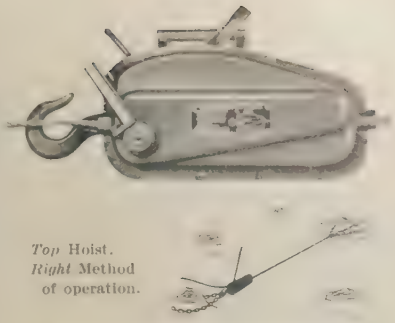
M. Reiter, Bludenz, Burs, Austria.

TIRFOR HOIST. — Designed for tree felling, stump pulling, log transportation and loading as well as for hauling of trucks sunk in soft ground. Operation is by reciprocating motion telescopic hand lever. Two automatic jaw blocks grip and carry the cable; the hoist can therefore be left with the load on without risk of the cable slipping. Even in case of a part failure, the load is still held. Lowering to the ground is always possible, the main working parts being duplicated, and, since the cable is independent, any tackle combination is quickly made, thus multiplying the rated power. *Specifications*: weight, 18 kg. rated power, 1½ tons; 2 control positions, 1 forward and 1 reverse.

Tirfor S.A., 16 Place de la République, Paris X^e, France.

MASTER 24 IN. DISC GRINDER AND SANDER. — Main features: the reversible disc permits efficient grinding of right and left hand jobs; adjustable table can be moved up or down 11 in. (28 cm.) exposing the entire face of the disc; table also tilts up to 30° and down to 45°. *Specifications*: *motor*: standard 2 h.p. 220/440 or 550 volt, 3-phase 60-cycle AC, 1725 r.p.m.; *disc*: boiler plate steel 24 in. (61 cm.) diameter × ½ in. (1.3 cm.) thick; *disc speed*: standard 1150 r.p.m., other speeds to order; *bearings*: double row heavy roller bearings at front and rear of shaft; *table*: normalized, cast-iron box-type, 13 × 30 in. (33 × 76 cm.). In normal position is 37 in. (94 cm.) from floor; *floor space*: 33 × 33 in. (84 × 84 cm.); *shipping weight*: approx. 900 lb. (408 kg.).

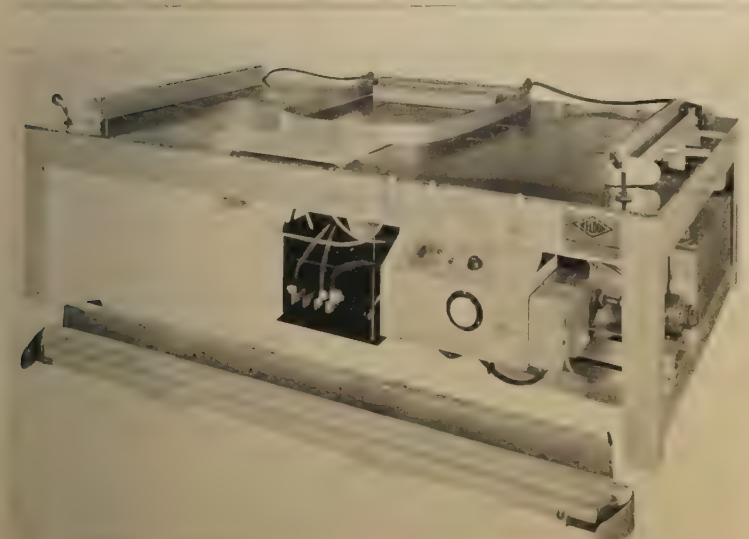
The Kindt-Collins Company, 12651 Elmwood Avenue, Cleveland 11, Ohio, U.S.A.



Top Hoist.
Right Method of operation.

SHARP-MASTER. — A light-weight portable power saw chain sharpener which can be used for all makes of chisel tooth chains to give the correct horizontal and vertical angles, cutting teeth to equal depths. It is equipped with a high-speed grinder and carbide burr. It can be easily resharpened.

Samuel C. Rogers and Co., 183-205 Dutton Avenue, Buffalo 11, N.Y., U.S.A.



BANDING PRESS. — Press frame is of welded structural steel. Press is complete with hydraulic power unit controlled by hand knob to any pressure desired. Heavy duty transformer with three taps provides high, medium and low heat. In addition, heat cycle is controlled by interval timer and thermostat. Threaded holes through center of table permit hard wood center bar or fence to be mounted parallel to press length, thus providing a double press to accommodate multiple loads of small panels on both sides of press in single heat cycle. *Specifications*: models available (dimensions indicate actual panel capacity): 48 × 74 in. (122 × 188 cm.) or 48 × 86 in. (122 × 218 cm.), 48 × 98 in. (122 × 250 cm.), 56 × 110 in. (142 × 280 cm.), all available with 3 in. (7.6 cm.) or 4 in. (10 cm.) high pusher shoes. Accessories include 16 ft. (4.9 m.) pull band, drawbar, dead block with mounting bolts.

Weldon Flinchbaugh and Co., York, Pa., U.S.A.

News of the World

The items appearing here are condensed from newsworthy material collected by FAO staff or submited by correspondents. FAO assumes no responsibility for statements and statistics in items accepted in good faith from contributors.

General

Argentina

● The first Forestry School in Argentina was established this year at the Facultad de Agronomia y Veterinaria de la Universidad de Buenos Aires. The course lasts two years, after students have spent three years on agricultural studies.

The Administración Nacional de Bosques has been assigned the task of establishing 1,000 hectares of shelterbelts in the Central Pampas to fight erosion. These shelterbelts are to be planted on private properties for demonstration purposes and to give impetus to other private owners. A standard contract to be used between the Forest Service and private owners has been worked out.

Cuba

● *The Forests of Cuba*, a study made possible by the Maria Moors Cabot Foundation in the United States, shows that two-thirds of the area of Cuba is satisfactory for agricultural crops and that one-half of the cultivated land is under sugar cane. The forests, which have been seriously depleted over the past 50 years, have shrunk from an original 60 percent to not over 15 percent of the total land area.

One of the major problems in providing wood for the urban centers is the lack of transportation from the forests to the cities. Often there is a wood shortage in these cities, despite their location not far from extensive forest reserves.

In 1946, Cuba produced 86 percent of its wood requirements and imported only 14 percent; by 1950, home production had fallen to 67 percent and imports increased to 33 percent.

The tremendous demand for wood for fuel is one of the principal factors in the serious depletion of Cuba's forests. Although more than 200 species of forest trees have some commercial importance, the forest consists for the most part of low grade stands which would require many years of management before they could produce a commercial volume of worthwhile species. Pine covers slightly over 1 million acres (400,000 ha.) but these are being cut at an alarming rate. The broad-leaved forests, covering over 3 million acres (1.2 million ha.), are in a condition of low productivity.

The study clearly presents the various factors of the environment covering geology, climate and land use. It describes the characteristics of the forests in the various parts of the country and provides information on specific counts from sample plots. The photographs and the lists of species facilitate the understanding of the different forest types. Altogether, the publication provides a useful body of information on the forests of Cuba as a starting point in future planning of the management programs that will be necessary to provide wood supplies for the island.

El Salvador

● The Republic of El Salvador is the most densely populated country of Central America. This is reflected in the pattern of land use; most of the land which can be used for agriculture has already been occupied, and the natural forests have been reduced to the remoter parts of the country or scattered areas which are not worth clearing to produce agricultural crops or for use as pasture.

Although the coffee plantations produce annually fairly large quantities of firewood and charcoal, the many privately owned *haciendas* outside the coffee belt where the forest areas occur, produce little timber. The country cannot supply its own wood needs and must therefore import.

The pine forests in the northern part of the country, mostly *Pinus oocarpa*, show much resemblance to the adjacent areas in Honduras; standing volumes of over 50 cubic meters per hectare are rare. The various oak species and scattered liquidambar that mix with the pine are usually poorly shaped. At higher altitudes there may exist some better forests of *Pinus pseudostrobus*, but these could not be big assets to the country.

Ireland

● It is reported that a road, 2.5 kilometers long, built entirely of oak was recently discovered under peat in Ireland at a depth of approximately one meter. The road gives the impression of having been built in the form of a bridge, with the tree trunks placed lengthwise in three layers resting on supports sunk to a depth of two meters. This is an unusual feature, since the ancient wooden roads were nearly always constructed with the trunks placed transversally. According to experts, the road dates back 1,500 to 2,000 years, proof of the remarkable resistance of the wood and the preservative character of the peat.

Japan

● The magnificent Hinoki (*Chamecyparis obtusa*) national forests originally belonged to the Imperial Household, but after the war were transferred to the national government. Most of the mature trees are about 250-300 years old, and the growing stock per hectare of a very old stand may be as high as 800-1,000 cubic meters. The forests are worked on a selection system on a cutting cycle of 25-30 years. Natural regeneration of Sawara (*Chamecyparis pisifora*), a species less valuable than Hinoki, seems to come up in abundance, so natural regeneration of the latter has to be supplemented by some artificial regeneration for which purpose large nurseries are maintained. Nursery stock about 3-years-old is used for planting. The usual rotation for artificial forests is about 100-120 years. Pruning of selected young trees is systematically carried out. Extraction, by forest railways cum cableways, is mostly carried out by the Forest Department and a very large workshop is maintained for upkeep of the equipment.

Hinoki is perhaps the most expensive wood in the world and all the temples and images in Japan — some 300 to 400 years old — are supposed to be made of this wood.

Northern Rhodesia

● The Government of Northern Rhodesia[1] announced its forest policy in 1949, when, from a 1948 survey, the forest estate was known to comprise some 1,638 square miles (424,242 ha.) or ½ percent of the country excluding Barotseland, which had a larger but ill-defined area of native authority forests.

In 1949, a Timber Survey Unit was established as a branch of the Forest Department to survey the timber resources of the Territory. It has since reconnoitered 30,000 square miles (7.77 million ha.). By its efforts

[1] Information on Southern Rhodesia and Nyasaland, the other partners in the new Federation in central Africa, has appeared in previous issues of *Unasylva*.

and those of the provincial forest staffs, the estate of forest reserves and protected forest areas is as stated in the following Table:

Area		Percentage	Forest authority
sq. miles	ha.		
1 930	539 870	12	Crown land
5 094	1 300 000	2.9	Native Trust land
901	256 669	1.8	Native Reserve
3 135	811 965	6.8	Barotseland
11 150[1]	2 908 504	3.8	Northern Rhodesia

[1] Of these, 4,235 square miles (1 million ha.) or 1.4 percent of the country are purely Protection Forests, while a much larger area serves for protection as well as production.

By the end of 1953, forest management plans covered all the main cutting areas and Barotseland. Two long-term forest working plans had been compiled and put into force, covering the Rhodesian teak forests and the copper belt, both of them very large areas indeed.

Fire protection of the Rhodesian teak forests has been re-organized and mechanized; more than 300 miles (480 km.) of wide firebreaks have been stumped in the last three years, and now are plowed annually. Six 90-foot (24 m.) high steel fire towers have been erected, and interconnected by telephone.

Areas under departmental early burning, were increased between 1948 to 1953 from 260 sq. miles to 1,430 sq. miles (67,300-370,400 ha.).

In 1949, the first full scale pine plantation was started at Chichele. By now, plantations total more than 1,200 acres (485 ha.). Some 500 acres (202 ha.) of test plots and trial plantings have also been established, at 19 centers up and down the country.

Cut-over areas of woodland which the department restocks by natural regeneration (through intensive early burning) has risen from 18,000 to 32,000 acres (7,300-13,000 ha.).

A principal scientific officer joined the Department in 1953, and a silviculturist at the end of the year. Apart from test plantings, the Department's research work now includes fire protection plots, plots to measure rates of tree growth, and a wide range of species introduction trials. The assistance of outside specialists has been obtained for certain specific investigations, including: sawing of fire-killed Rhodesian teak (1949), preparation of a check list of trees and shrubs (1952), and possibilities for wood pulp (1953).

The Department extended its nursery at Lusaka to supply the public with ornamental trees and shrubs and by 1953 it was producing 120 kinds of trees and carried a stock of $^3/_4$ million plants.

Wood production rose from 690,000 tons in 1948 to 1,181,000 tons in 1952. A new concession designed to make available timber for the copper mines for 17 years was put to public application in 1953, and issued in 1954. The market value of wood produced from forests under the Department's control had risen by 1953 to £ 2,000,000 for that year being higher than the value of the country's maize crop. However, timber imports for the year also totalled £ 2,000,000.

The mushroom growth of the Forest Department has not been out of line with the economic growth of the country as a whole. It still falls somewhat short of what is needed. Indeed, in securing land on which to grow the country's future supplies of wood, and in the work of reserving the heads of principal river catchments as "protection forests," by 1953 the Department had reached only one-eighth of its target.

Peru

● A journey performed by air betueen Lima and Cusco, and between Cusco and Arequipa, provides an opportunity of observing the distribution of vegetation, or rather the lack of distribution of vegetation, in South Peru.

An interesting forestry feature of the Cusco region is the cultivation of *eucalyptus* at high altitudes, 11,000-12,500 feet (3,300-3,800 m.). The plantations are raised without irrigation and are often of open formation, which enables the cultivation of crops, such as maize and barley, below the trees. The trees are pruned and are of excellent form and height growth, so that every tree is valuable.

Of interest also in the Cusco region, from the soil and water conservation point of view, is the high standard of conservation obtained with the terraced cultivation on steep mountain sides, a tribute to the engineering skill of the Incas. On the way between Cusco and Machy Picchu, after the commencement of the semi-tropical vegetation, some old Inca terraces which had been overgrown by vegetation are being cleared and brought into use once again.

An important forestry-colonization project in Peru at present is the Le Tourneau concession of 400,000 hectares of jungle on the Pachitea River, one of the headwaters of the Amazon. The concession holder has brought heavy equipment by water up the Amazon and its tributaries to the concession area, and the project is said to be making good progress. One item of the project is the construction of a first class road over the Andes Cordillera from the concession area on the east side of the mountains to link up with the road and railway system of central Peru on the west side of the Andes. This new line of communication should have a great effect on stimulating the use of timber from Amazonian Peru.

Fundamental Science

Canada

● That climate is changing toward moderation in many parts of the Northern Hemisphere was perhaps recognized earlier and more widely in Europe than in North America, but the effects of the changes on life have been noted and studied for some time on both sides of the Atlantic Basin. The increasing temperatures, generally decreasing precipitation including snowfall, and increasing periods of drought have had direct results, such as retreat of the glaciers and an increase of ocean temperatures resulting in northward migration of several kinds of fish of great commercial importance, for example, around Greenland and Iceland.

In Canada, while recognition of the changes has increased, attempts to relate them to the behavior of plants and animals is relatively recent. Some of the changes of the past half century have been to the good, such as the advance of the northern tree line, and better growth of older stands near the line. Associated with the change, however, are other detrimental consequences, such as the frequency of major insect attacks such as those caused by the larch sawfly, the larch casebearer, the spruce budworm, spruce sawfly, the balsam woolly aphid, the beech scale, the birch leaf skeletonizer, and birch leaf-mining sawfly. Similarly, epidemics of diseases have been prominent including the white pine blister rust, chestnut blight, oak wilt, Dutch elm disease, and the deterioration of residual stands of birch.

These manifestations have not been specifically related to climatic changes, but speculatively at least they may be. The changes have the general effect of weakening trees and forests, and perhaps man's actions in affecting the forests, important as they are, may be subordinate to the effects produced by widespread changes in climate.

The effects of the changes on wildlife species, particularly game, have been pronounced. Some of the northern mammals, such as the caribou and moose, have moved out of former southern portions of their ranges, and southern animals, such as the Virginia deer, have moved north and to some degree replaced the northern mammals in portions of their range.

United States of America

● A research note issued by the Southeastern Forest Experiment Station on the characteristics of high-gum-yielding slash pines shows three controlling factors.

1. the size of the radial resin ducts exposed by chipping;

2. the number of resin ducts per square inch of fresh streak;
3. how viscous or fluid the gum may be.

There is a possible fourth characteristic, the pressure within a tree which tends to force gum outward, but this has not yet been susceptible to quantitative measurements.

If these factors prove to be inheritable characteristics, then controlled breeding of carefully selected, high-yielding parents may result in multiplying good strains of progeny.

Silviculture

Canada

• Studies of rooting Douglas fir (*Pseudotsuga taxifolia*) cuttings in British Columbia yielded results which differed from those of other similar experiments in that best success was obtained with cuttings from older trees (82 years old) rather than from younger trees (16 years old). Use of both a fungicide and a rooting hormone was necessary to induce root growth and, in addition, it appeared desirable to retain a basal bud in making cuttings. Only 14 percent of the trial cutting not treated with fungicide rooted, whereas 51 percent of all treated cuttings were successful.

Morocco

• In an excellent illustrated brochure *Forest Vistas* issued by the French Residency General in Morocco it is recounted how in 1912, when Morocco became a French protectorate, vestiges of very fine forests were still to be found mainly in the mountains where they had escaped attention. Elsewhere ill treatment had almost exterminated the ancient forest.

The Moroccan Forest Department, while trying to save what was left of the existing forests, from the start attacked the problem of afforestation. While, in more fortunate areas, the traditional conservative methods as taught by the French School of Forestry were applied, a team of younger men was busy on the techniques of replanting arid land.

From the sea coast or the fringe of the desert up to the snowy tops of the Atlas Mountains, a complete range of climates is experienced, but everywhere drought occurs in summer. The local vegetation consists of species adapted to the prevailing conditions in each belt of altitude such as local gum-bearing acacia, argan, Magrebian thuja, cork-oak, holm oak, pines, junipers, cedars.

These trees, however, grow very slowly, so emphasis was put on quick-growing species of foreign origin, such as eucalyptus and acacia.

Planting programs have received the support of officials, the Moroccans and settlers and have made fairly rapid progress. The Moroccan Forest Fund, copied from a similar fund which has been successful in France, has helped with financing. Now, planting is taking place at a rate of some $6\frac{1}{4}$ million seedlings annually over an area of 14,900 acres (4,600 ha.) With a population of roughly 8 millions, this represents an average of almost one tree a year for each inhabitant. Such a rate has never been attained in any other Mediterranean country.

Forest Injuries and Protection

Canada

• Studies on forest pathology reported in the *Journal of Botany* deal with yellow laminated root-rot of Douglas fir, decay of western hemlock in the Upper Columbia region of British Columbia, and decay in sugar maple in parts of Ontario.

Yellow laminated root-rot, though occurring in most native conifers throughout the range of Douglas fir in British Columbia, is most prevalent and damaging in this species because the disease commonly effects an entrance through root fusion which is more usual with Douglas fir than with the other species. The disease is caused either by a variety of *Poria weirii* or another species of *Poria*, and attacks Douglas fir at any age over six years. Individual trees differ greatly in resistance for reasons not fully understood. The inoculum may remain viable for over half a century but does not spread through the soil nor penetrate healthy bark tissue. The disease can kill the fir, particularly young trees, and thus is particularly dangerous as young stands replace the present mature forests. Economical methods of controlling established infections have not yet been fully worked out.

Sample plot and tree dissection studies show that decay losses in western hemlock stands can average 52 and 74 percent of the cubic and board foot volumes respectively. No less than 26 decay-producing fungi contribute to this excessive loss, but nearly two-thirds of the total appear due to *Echinodontium tinctorium* and 25 percent to *Fomes pini*. Loss due to the first species decreased, and to the second increased, with increasing site quality.

Immature hemlock is susceptible to decay, and an advanced stage of deterioration is reached at an age of about 250 years. A method of estimating stand defect within 7 percent has been developed from the studies.

Decay was found in 74 percent of the sample sugar maple trees, associated with no less than 28 fungi. *Armillaria mellea* is most serious in causing butt decay and *Polyporus glomeratus* the most important trunk rotting species. The usual means of entry are frost cracks. Most maple stands have replaced original white pine forests, and forest management is faced with the problem of whether the costly effort should be made to restore white pine to these sites. On pathological grounds there are doubts whether such a program is sound.

United States of America

• Earlier work in developing a blister rust control policy for the national forests in the northern Rocky Mountain region, showed that the correct approach was to deal with the white pine rather than rust control as such; that management needed to be concentrated on compact working units; and that a wide range of silvicultural measures might be applied to maintain and improve the yield of the desired *Pinus monticola* while at the same time controlling or reducing the population of *ribes* bushes.

More recent work and analysis show that excessive *ribes* becomes established in full sun or on lightly shaded sites after fires, logging or other major disturbances to forest cover and forest soil. In stands of more than 50 percent shade the mortality of *ribes* seedlings is high and growth is slow.

Since *ribes* springs up from seed stored in the forest floor, the basic strategy is to exhaust this supply coupled with eradication of existing *ribes* plants. Light and moderate cuttings aid *ribes* suppression but tend to favor shade-tolerant and desirable tree species in reproduction. Clear-cutting followed by properly timed broadcast-burning and planting, aids in *ribes* suppression and appears to lay the basis for maximum white pine yield. Cleanings, thinnings and pruning improve white pine quality and yield but have little effect on *ribes* suppression.

• Forest fires at times "blow-up," a violent, erratic and unpredicted behavior surprising even experienced fire fighters. Studies of the specific weather conditions responsible for such phenomena are by no means complete, but it is possible to identify certain weather conditions by their visible characteristics and to relate each condition to its effect on fire behavior. Fire-fighters need to be trained in recognition of these conditions so that they can take appropriate action in fire suppression.

Broadly speaking, an air mass is either stable or unstable. In stable air, vertical motion is suppressed mainly because the underlying air is relatively cooler and heavier whereas overlying air is relatively warmer and lighter. The temperature decreases no more than 5° F. for each 1,000 feet (4.7° C per 500 m.) increase in elevation. Indicators of stable air include clouds of stratus or stratified type showing no vertical motion; surface wind is steady or calm; smoke tends to lie in layers with visibility poor in the lower layers. A special form of stability

is inversion, in which temperature increases with height and which is identified by flat tops of clouds or fog layers at the height at which cumulus clouds cease to rise and a rising smoke column levels off. Such conditions tend to weaken the lower layer draughts into and above a fire and thus reduce the fire intensity and "spotting" potential.

Unstable air has greater decrease in temperature with increasing height (5½° F. or more per 1,000 feet or 1° C per 100 m.), vertical motions are accelerated, and upward and downward currents develop. The main indicators are erratic surface winds with gusts and lulls, and variation in direction and turbulence above the surface layers. Clouds are of the cumulus type with pronounced vertical dimension and restricted horizontal dimension. Smoke, dust and haze are dispersed by air movement and visibility is generally good. Instability affects fire through spreading by gusts, rapidly rising columns of smoke, stronger indraught at the base of the fire, hotter burning fire, and a greater tendency for fires to "spot."

More specific phenomena of instability described in *Fire Control Notes* include:

1. turbulence, marked by irregularity of air motion, bumpy air for aircraft, and gusty wind at the ground;
2. gustiness, with surface winds varying rapidly in both vertical and horizontal speed and direction. Fires spread spasmodically in unpredictable directions and fluctuate rapidly in intensity and rate of spread;
3. convection, rapidly rising warm air and descending cool air currents. The more intense and convective circulation, the hotter and faster the fire will burn and the higher burning material will be carried;
4. thundersqualls, that is, sudden winds blowing outward from beneath a thunderstorm and which may extend for a mile or more ahead of the storm's edge before rain arrives.
5. whirlwinds, usually associated with extremely unstable air such as may be due to a fire itself. The lesser type of whirlwind, dust whirls, though small in diameter, can throw small debris for some distance in addition to intensifying the fire and its spread as they pass. The larger fire whirlwind is due to the fire itself and has both horizontal and strong vertical components and is thus very liable to spread a fire to considerable distances;
6. the fire storm, a violent convection caused by a large, continuous area of intense fire comparable to the fire storm created by bombing raids from aircraft. Surface draughts into the base of the fire may be destructive and violent for several hundred yards outside the fire and may lift burning material several miles high.

Venezuela

• Since 1947, the Government has been actively concerned with soil conservation in the basin (watershed) of the river Tacagua, west of Caracas, a valley linking the capital with the coast and constituting its principal route of access. Formerly forested, the area has suffered from shifting cultivation, overcutting (fuelwood and charcoal found a ready market in Caracas) and from goats. By 1946, erosion had reached disastrous proportions and virtually all wildlife, particularly birds, had been exterminated by hunting with a consequent increase of harmful insects. Investigations showed that the population responsible for the deterioration of the area consisted only of 77 families, by this time eking out a precarious livelihood, while the number of goats was estimated to be about 14,850 of which 7,370 were located actually in the Tacagua basin. Vegetation approximated to a desert flora, with only traces of the former dry type forests.

No rehabilitation was possible without strict control of goat grazing which provided virtually the sole livelihood of the indigenous population. The task of control was undertaken by the Forest Service. In July 1948 a regulation was issued forbidding uncontrolled goat grazing in the Federal District on land having a gradient of more than 15°, and permitting its practice elsewhere only under the authorization of a qualified official. The sale of goats was organized by the Forest Service, and by 1950 the goat population had been reduced by 6,521 in the Tacagua basin and by 9,604 in the rest of the Federal District.

Only two families could be persuaded to leave the area for more favorable living conditions elsewhere; the rest stayed, most of them to work under the Forest Service. Fuel oil was supplied at a special rate to the families, and the cutting of wood for fuel strictly prohibited.

Research on the best rehabilitation methods was carried out, three experimental areas being established: the first for artificial reforestation, the second for natural regeneration, and the third for special experimental planting.

Experience on the second area showed that the elimination of goats alone was sufficient to secure a relatively swift recovery of the natural vegetation.

The effects of the measures soon began to be felt. [illegible] water courses were again filled with water throughout the year and [illegible] becoming restocked with fish, while wildlife, under strict protective measures against hunting, was being re-established.

Mensuration and Surveying

Germany

• The application of aerial photography to German forestry was discussed at a meeting of foresters at Tubingen in April this year. An interesting demonstration was also given of the projection of aerial photographs by means of polarized light so that the stereopicture may be studied by several persons simultaneously. This method seems to offer excellent possibilities for demonstrations and educational purposes.

The system of survey used in the Länder of Württemberg deserves notice. In 1953, the use of the modern Eagle camera (size 22.5 × 22.5 cm, f = 30.5 cm) was introduced; the photograph scale is about 1:10,000. The fairly large focal distance has the advantage that errors due to height differences in the field are less troublesome for the mapping method used.

The number of photographs per Forest Division amounts to an average of 80. More than half of all Divisions in Württemberg are now covered by aerial photographs. The inventory method is to project the photo image on a table top, the height and slope of which may be regulated. The photograph, enlarged four times, is projected on to the existing cadastral map 1:2,500, which is very reliable. By adjusting the table top, the forest boundaries can be made to coincide with the corresponding boundaries on the map. Any differences in scale and errors caused by tilt are sufficiently eliminated, whilst it is further possible that errors due to parallax differences are greatly reduced by continuously adjusting on a certain subdivision boundary, thus covering only a very limited part of the photograph. For areas where differences in altitudinal height are small and for which good detailed maps are available, this method may prove very serviceable.

For the identification of tree species, especially of broadleaved trees, flights in summer are best. Experience has shown that interpretation is easiest when photos are taken at the sun's maximum altitude, i. e. higher than 45°, because then the shadow parts are smallest. This means that the best time for flights is in midsummer (June-July) between 10-14 hours.

The costs of air survey are about 6 cents per acre, which, in proportion to the total cost of survey work in Württemberg (about $ 2-$ 3 per acre or $ 6-$ 7 per ha.) is practically negligible.

SURINAM

• Air survey work in Surinam disclosed a close correlation between vegetation and topography. For the flat and nearly flat country it was impossible to draw a good topographical map from the aerial pictures without a thorough knowledge of the vegetation cover. In hilly and mountainous regions it was in general easier, but even here it was necessary to know something of the vegetation for the proper discernment of topographical detail. Since Surinam is almost entirely covered with tropical forest, it was necessary to make a thorough study of the forest. This work was undertaken between 1949-1953 and entailed extensive traveling, checking the aerial pictures and detailed sampling of the forest, so far as was practicable.

The results of the work are dealt with in a bulletin entitled *Vegetation and aerial survey in Surinam* by a specialist who is now with the FAO forestry mission to the Amazon.

From studying the vegetation on the ground it was possible to correlate it with six primary regions:

1. salt or brackish water swamps (mangrove forest etc.);
2. swamp areas (water-logged the year round);
3. areas temporarily flooded, mostly along rivers and creeks;
4. savannas — divided into sandy and clay savannas;
5. dry country — classified as sandy, clay or stony areas;
6. areas occupied or formerly occupied by man. In some instances former occupation may date back as far as two hundred years. These areas are generally covered by secondary forest.

Some 900,000 hectares of forest were sampled, mostly dryland forest. The important timber-bearing forest types have been segregated into two major associations:

(a) *Eschweilera - Dicorynia* association;

(b) *Eperua - Eschweilera - Dicorynia* association.

These are each subdivided into recognizable consociations, each characterized by the identity of the dominants, there being 5 and 7 consociations in the two associations respectively. There are 12 dominant and co-dominant species.

It has been said that tropical rain-forest can change totally in the course of one tree age. If this were so, it is possible that in 100 to 200 years all the valuable species of today could be replaced entirely. This idea is supported by the observation that no regeneration is evident in the vicinity of old dominant trees. The survey endeavored to discover if this was likely to be true over the large areas with which forest management would be concerned. In the course of random sampling, measuring all trees of 10 inch (25 cm.) DBH (diameter at breast height) and up, trees which stood with crowns free above their associates were separately recorded, this in fact automatically dividing the data for the upper horizon of the forest into two stories — an upper and an under-storey. This showed that there were two groups among the dominants and co-dominants, each of which lives in its own milieu. The group *Eschweilera longipes, Eschweilera corrugata, Tetragastris* sp., *Eperua falcata* and *Schwartzia* spp. are from the under-storey group, and the other dominants distinctively from the upper-storey group of this kind of forest. These two groups cannot replace each other.

Additional information was gathered relative to the three most valuable species — *Dicorynia paraensis, Goupia glabra, Ocotea rubra.* It was found that, of a total of 2,892 trees of *Dicorynia paraensis* measured, 743 were in the 10 to 14 inch (25-36 cm.) diameter class: in the case of *Goupia glabra* 334 of the total of 1,935, and for *Ocotea rubra* 90 of the overall total of 595. These trees are the strong young trees which have a good chance to grow fully in the upper-storey. There was no evidence to establish definitely that these numbers were sufficient to maintain a desirable percentage of these three species in this kind of forest, but it was concluded that this number[3] of young trees is in fact sufficient.

Forest Management

CANADA

• Forest management licences granted by the Provincial Government to three of the largest operators in British Columbia carry the obligation to build not only logging roads through the sections of State forest land in the southwest area of Vancouver Island covered by the licences, but also modern paved highways fully available to the public and designed to link up with, and form part of, the provincial highways system. This is the first time in the five years that the present system of forest management has been in operation, that a compulsory road building clause has been written into the terms of a forest management licence.

NORWAY

• It is reported that the Ministry of Agriculture, in co-operation with provincial heads of forest administration and aided by funds from the United States Foreign Operations Administration, is planning 120 demonstration forests throughout the country. Designed to demonstrate the advantages of systematic forest management and mechanized operations, the project is aimed primarily at farmer-owned woodlands covering from 20 to 200 hectares. Norwegian authorities expected some 30 demonstration areas to be started this year.

UNITED STATES OF AMERICA

• Tests of a tractor-mounted chipper for slash disposal on the Sierra National Forest are reported to have given good results at a cost comparable to hand methods.

The chipper used has a 11 ½-inch (29 cm.) diameter head with four 15-inch (38 cm.) cutters turning at 1,800 to 2,000 rpm. The maximum knife setting is $^3/_8$ inch (1 cm.). The chipper weighs a total of 1000 pounds (450 kg.). Material up to 14 ½ inches (37 cm.) wide or 6 to 8 inches (15-20 cm.) in diameter can be chipped by the unit. It is mounted on the rear of an International TD-14 tractor and driven from the tractor's power take-off by six V-belts, which raise the drive rpm. from 1,400 to 2,200. The tractor has a bulldozer. The chipper is fed from the tractor side by a chute, which is elevated to give a down slope into the chipper of 10 degrees. A rotable deflector on the discharge chute permits the spreading of the chips over a range of 180 degrees behind the tractor.

The work was done on skid trails, ridge tops and along roads of a logging operation in mixed coniferous forest between 5,500 and 6,500 feet (1,680 and 1,840 m.) elevation.

Slash disposal, soil stabilization and cross drainage for roads and skid roads were accomplished at one time. Three of the 5-man crew cut material to 6-foot (1.8 m.) lengths in 10-foot (3 m.) strips along each side of the treated area. One man fed the chipper and one operated the tractor. As the tractor went up the skid trail, the material on one side was treated. On the return trip down the road, the other side was treated and the bulldozer was used to construct cross drains.

From 6 to 10 percent of the area was given this treatment for slash disposal and erosion control; a layer of chips, from one to two inches (2.5-5 cm.) thick, covers the treated area. The technique has the following advantages:

1. it speeds decay of material and subsequently results in more fertile soil;
2. both soil creep and water-borne soil movement are retarded;
3. a higher surface soil moisture content is maintained throughout the summer, and conifer seedlings have improved chance of survival;
4. it is thought that this higher moisture content will lessen the chance of fire;
5. it is hoped greatly to reduce the fire hazard and hin-

[3] *Life* magazine carried in its issue of 18 October 1954 an interesting popular and illustrated article, "The Tropical Rain Forest," in its series "The World Around Us."

drances to fire control measures which are ordinarily characteristic of cutover lands.

The cost for the slash disposal and soil stabilization on the 41-acre (17 ha.) experimental area amounted to $ 32.71 per acre ($ 80.83 per ha.); ditching of the skid trails and roads $ 0.09 per thousand feet; total cost was $ 34.93 per acre ($ 86 per ha.). Costs using hand methods are $ 32.84 per acre ($ 81.15).

Industry and Trade

Liberia

• The Government is reported to have awarded an 80-year concession covering over 100,000 hectares of forest to a German firm. The contract permits use of all available forest products within the concession area. Apparently, among other projects, the firm will build a wood pulp and chipboard mill. Inaccessibility, as reported in *Unasylva*, Vol. VI, No. 3, has always been a great obstruction to the development of Liberia's forests.

Swaziland

• Over 100,000 acres (400,000 ha.) of forest land in the Usutu area of Swaziland were purchased by the British Colonial Development Corporation in 1949. Around 80 percent of this area was considered suitable for planting with *Pinus patula, caribaea, taeda,* and *pseudostrobus,* with a view to pulpwood production in from 10 to 15 years, and saw timber later. By the end of 1953, nearly half the total area available had been planted and, despite rising wages and prices, the program was still within the original cost estimates. Apart from some minor damage by hail, the condition and growth of trees was satisfactory. More than 37 miles (60 km.) of roads were completed in 1953, making 139 miles (254 km.) in all.

Preliminary discussions have been held with commercial interests with a view to participation in management, and in 1954 an expert mission was to draw up detailed plans for the investment required. It is thought that this huge forest, with its good water supply and a promised railway link, could become the site of the first integrated forest industry to be established in Africa, combining low cost pulp and paper manufacture with sawn wood, and at a later date wood chemicals as well.

United Kingdom

• The Minister of Agriculture and the Secretary of State for Scotland have appointed a Departmental Committee with the following terms of reference:

> "With the object of promoting confidence and stability, and bearing in mind both the output from Forestry Commission woodlands and the need to develop markets, to consider what measures might be taken within the home timber industry to improve the arrangements for marketing produce from privately owned woodlands; and to report."

Forest Products and their Utilization

Canada

• In 1951, a program of fundamental sawmill research was begun by the Federal Forest Products Laboratories Division, involving establishment of an operational-sized mill equipped with specially designed recording and measuring devices in order to study such matters as:

(*a*) specific gravity of the wood being sawn and power requirements of the headsaw;

(*b*) depth of cut and power requirements;

(*c*) bite per tooth and power requirements.

Since 6,000 of the 7,000 odd sawmills in Canada are of the circular headrig type, the initial work dealt with this type of mill. Research in this field in other countries has been mainly on a laboratory scale, and thus the Canadian enterprise was breaking new ground.

Horse-power requirement bears a positive linear relationship to specific gravity both within and between the species tested. The actual values derived are materially greater than those reported from other studies, ranging from 55 h. p. at headsaw for a 0.38 gravity to 110 h. p. at 0.66 gravity.

The effect of increasing depth of cut is to increase power requirements proportionally, the actual requirements again exceeding those found in other studies and ranging from 21 h. p. at headsaw for 4 inch (10 cm.) depth of cut to 77 h. p. for 12 inch (30 cm.) depth of cut.

Varying the bite within given saw speeds changes power requirements proportionally, the rate of change being much more rapid at faster saw speeds and the effect of specific gravity also being more severe at higher saw speeds. Again power requirements were greater than in other studies.

Future work involves determination of the optimum relationship between saw swage and gauge, the effect of tooth sharpness on power requirements, the effect of tooth hook angle, clearance angle, and gullet capacity on power requirements and the effect of the number of teeth on power requirements. In addition, tests are now under way to compare the operation of a chrome-plated circular saw to that of similar sa[illegible] conventional design. A comparis[illegible] also being made between thre[illegible] of teeth — hollow ground, diamond, and flat — and conventional teeth.

Additional equipment, particularly a log turner, utilizing carriage movement as motive power, is being designed for the research sawmill. The long-term aim of the project is to provide a sound basis for improving design and operation of sawmill machinery in the interests of higher recovery of useful material.

Ceylon

• A FAO Technical Assistance Officer writes: "It has been standard practice to use imported teak of random widths as flooring boards. As a result of the efforts of the Forest Department a local timber is now gaining popularity and we have supplied a number of sample quantities of strip flooring, kiln dried to 12 percent, with a "secret nail" joint. The floor of the new saw doctor's shop was laid in this manner and it is mainly as a result of its success that the popularity of strip flooring is gaining. One of the reasons for random width flooring being used was the saving of time in the laying operation i. e. a larger area being covered by each wide board. However, it has now been proved that the yield of strip flooring per log is greatly in excess of wider boards and this easily offsets the extra cost of laying strips. The two further advantages are the absence of shrinking on a strip floor and with secret nailing, the absence of nail holes. There is also a considerable advantage in the appearance of the finish. The timber used is Hora (*Dipterocarpus zeylanicus*).

Sweden

• A correspondent indicates that the findings of Dr. Paul Lange, of Stockholm University, in a doctoral thesis presented recently, are expected to become of great value to research in wood chemistry.

Dr. Lange's subject was the distribution of cellulose, hemi-cellulose and lignin within wood cells. He found that the lignin content of the wood cells, which he likens to small tubes with closed ends having a wall thickness of a few thousandths of a millimeter, is stored principally in the outer portion of the cellular wall. Acting as a glue, binding the cells to each other, it gives the wood part of its typical mechanical properties. The cellulose proper is contained in the inner wall of the small tubes, while the hemi-cellulose, so important for paper making, is concentrated in the outer part of the tube.

This research into the micro-elements of wood has necessitated the use of advanced micro-optical methods, the particles analysed being in certain cases no bigger than a millionth gamma (gamma in turn

being a millionth of a gram). The findings are expected to become of great value to research into the diffusion and penetration processes which take place in the fiber wall when wood is subjected to chemical processes in pulp making.

United Kingdom

• One of the most important developments in the technique of furniture manufacture during recent years has been the introduction of synthetic resin adhesives. Within a few years, these have been widely adopted, although the traditional animal glues are still popular. Perhaps the main reason for the success of synthetic adhesives has been the fact that, by the application of heat, their setting times can be very considerably reduced.

Of the methods of applying heat some of the more convenient and less expensive methods are based on the use of electrical resistance heating. These methods are the subject of a report published by the Furniture Development Council. Four methods in which the electricity supply is used at the original mains voltage, involve the use of rubber sheets in which resistance wires are embedded, cylindrical heating elements, glass mats into which the heating wires have been woven, and cauls made by the user from resistance wire and resin impregnated paper.

In the other methods the mains current is passed through a transformer, so that only low voltages are applied to the heating elements. These are generally metal strips, but the process has been developed so that larger areas can be heated by means of metal sheets. In the last method described, resistance wires are inserted in the glueline itself.

With the exception of this last method, the heat is applied to the surface of the wood and therefore these techniques are particularly suitable for work where the glueline is fairly close to the surface, such as veneering. In such cases very short setting times can be achieved.

United States of America

• A new $ 3 million wood products laboratory building at the State University of New York College of Forestry will house the forest utilization, wood technology, and forest chemistry departments.

The College envisages the new laboratory as an aid to its three functions of academic education, public education, and research. New semi-commercial and commercial equipment will better prepare students for professional work.

Several new pieces of machinery and apparatus will be installed in the new laboratory. In the veneer and plywood laboratory there will be a lathe with a 54-inch (136 cm.) knife and 36-inch (90 cm.) swing which will handle bolts of a minimum length of 16 inches (40 cm.). It will be possible to produce veneers of 20 different thicknesses. A wet veneer clipper with a knife operating at 250 strokes a minute will be controlled by push buttons. A new veneer clipper attachment, dryer, and splicer, together with a glue mixer and spreader and a plywood press, will also be included.

A 400,000-pound (174,000 kg). Universal testing machine will be a feature of the mechanics and physics laboratory. The machine is a new development in wood testing and still in the design stage. A stress-strain recorder on the machine will be operated electronically.

The research surfacer in the woodworking laboratory will have a feed of 20 to 60 feet (6-18 m.) per minute. Its cutting speed will be 1,000-20,000 rpm. With mounted tachometers, the research jointer and table saw will be able to handle stock at speeds varying between 1,000 and 20,000 rpm.

A wood preservation laboratory will include five impregnating cylinders, vacuum pumps, five 1,000-gallon (3,800 liter) storage tanks, and a 1,500-gallon (5,000 liter) sump tank. There will be five dry kilns with gas and steam heating. Three rooms will be provided for testing plywood, preservatives, and moisture. There will also be five temperature and humidity control rooms.

The timber preparation laboratory will house a sawmill and associated equipment. Four more rooms will be devoted to the wood finishing processes. They will provide space for the mixing of various finishing materials, for application of the finishes, and for their drying and testing.

Facilities on the first floor will be provided for research and instruction in the fields of plastics and paper coating. The second floor will house a physical and analytical chemistry laboratory, a wood chemistry laboratory, two conference and library rooms, faculty and graduate offices, a viscose preparation laboratory, a temperature control room, a cellulose laboratory, an inoculation room, and a laboratory equipped with an X-ray machine and a mass spectrometer.

• The Bell Telephone System has in use about 20 million wood poles to carry its wires and cables, and thus is vitally interested in preservative treatment. Because of size requirements, several western species — western cedar, Douglas fir, lodgepole pine and western larch — are used extensively to supplement the southern pine poles.

At the laboratories, tests are made by the soil-block method, and these are supplemented by test plot experiments with $^3/_4$ inch (1.9 cm.) small stakes, with tests of pole-size specimens and, in the field, test lines have been selected for long-term observation — that is, experience and service tests. A comprehensive analysis of results has been issued, involving not only the company's own work but also analysis and evaluation of the large technical literature existing in the field from both North America and Europe. Comparisons are not easy because there are as yet no generally accepted and fully standardized methods for making the various tests; the publication in question describes the methods and standards used in the company's laboratories.

The major conclusions are:

1. The soil-block technique incorporating a weathering procedure is a practical, rapid method of test, and the results obtained are in general agreement with stake and post tests for identical or similar preservatives. Thus a creosote retention at treatment of 9-10 pounds per cubic foot (160 kg. per m³) is required for permanent preservation in test blocks, in $^3/_4$ inch (1.9 cm.) stakes and in the outer one inch of test posts.
2. The good reputation of well-creosoted material is confirmed and causes of failure and remedies have been identified.
3. Block tests may be used immediately to establish the required amounts of preservative distribution in the wood.
4. Soil block results with creosote compared to results of European agar-block tests show the latter to be far below the actual requirements in treated wood. An international attempt to study and harmonize the results from the different techniques seems desirable.
5. The laboratories' controlled weathering procedure provides a means of determining effective retentions for both oil-type and salt-type preservatives.
6. The tests explain and confirm the results of actual experience.

Forest Policy

Bolivia

• A Forest Service was created by law on 1 February 1954. The new Forest Service under a Director-General is attached to the Ministerio de Agricultura, Ganaderia y Colonización. It will be responsible for carrying out a national inventory of forests and other renewable resources, including grazing lands; for the creation and classification of forest reserves; for the technical and economic control of forest extraction, afforestation and reforestation (particularly on eroded land); for the conservation, improvement and economic utilization

of the soil; and for the protection of wildlife and the control of hunting.

This law also declares all existing natural forests of economic, climatic, edaphic, hydrologic or military importance to be "instruments of national defense," and places under the forestry administration all land with forests and natural pastures owned by the State, or by universities, counties, townships, associations and co-operatives; areas classed primarily as forest, regardless of ownership, and lastly, land unsuited to agriculture for reasons of geographic location or soil characteristics.

Brazil

• A law passed in January in the State of São Paulo represents an interesting experiment in legislation aimed at encouraging the afforestation of uncultivated land and the care of forests under private ownership.

With some exceptions, land tax will be increased from 50 to 100 percent for all landowners from 1955 to 1984. However, landowners will be exempt from this increase if they can prove that their land is satisfactorily maintained under forest either naturally or artificially, or that afforestation measures are being taken affecting 10 percent of the area from 1955 to 1959, 20 percent from 1960 to 1964 and 30 percent from 1964 onwards, and provided that these measures are undertaken without assistance from the State. In the case of properties of less than 50 hectares, all plantations of fruit trees and ornamental trees are to be counted in the forested area, and properties of less than 10 hectares are exempt from the increase on condition that one-fifth of the area is planted with trees, even if only with orchards or row plantations.

The funds derived from this tax increase will be added to the State budget devoted annually to forest protection and research, and to the production of forest seeds and plants for rural landowners.

Costa Rica

• A mission appointed by FAO to study forest development, at the request of the Committee on Economic Co-operation of the Ministers of Economy of the Central American isthmus, reports that forest reservation should be a major concern of the government.

"In a country like Costa Rica, with rapid streams and a heavy rainfall in most sections, the protection of watersheds is necessary for present or potential waterpower developments, and consequently many headwater areas should be kept permanently under forest even if the soil is suitable for farming. Usually there is strong public pressure for land to be classified as agricultural; it is necessary to look beyond this demand of the moment, weigh future benefits against present gains, and base decisions on the type of use that will in the long run be of most benefit to the country."

This should form the basis of forest policy in Costa Rica. Moreover there is another reason why forest reservation is important. One of the Inter-American Highway's greatest assets will be its scenic and recreation value. The exploitation of the forests along this highway in Costa Rica, as is now going to happen with the magnificent oak forests, will mean a tremendous loss to Costa Rica. Parts of these oak forests should in any case be preserved in their original state for scientific reasons, because *Quercus copeyensis* is a very rare species and grows to greater dimensions than probably any other oak in the world.

Greece

• The following important amendments were introduced into the Forestry Code of Greece by a law promulgated in August, 1954:

1. The Minister of Agriculture, by agreement with the Technical Forestry Council, has been given the power to compel forest landowners having more than 8,000 hectares, either individuals or collective owners, to employ a trained forester. Suitable foresters can be recommended by the Minister but the choice of appointment is left to the landowners.
2. The development of State forests where exploitation was difficult owing to lack of communications, or where there were no local industries capable of absorbing the timber output, was previously almost impossible due to the rules limiting the grant of felling concessions to one year only. The new law provides that concessions in such forests may extend over several years, up to a limit of five years. This limit may even be raised to ten years in the case of certain industries requiring much capital investment.
3. Royalty rates payable on products from the concession will be subject to revision every two years on the basis of the price index published by the Bank of Greece.
4. Where the annual output exceeds 4,000 cubic meters of industrial wood, an operator is obliged to employ a forester to supervise extraction. If necessary, the appointment will be made by the Minister of Agriculture.

Regulations also cover cases where the produce from State forests, worked by State employees, is sold to contractors. Contracts of this nature can be repudiated [illegible] without compensation [illegible] party, subject to the a[illegible] the Minister of Agriculture a[illegible] agreement of the Technical F[illegible] Council in cases, for instance, where:

(*a*) the estimates on which forest exploitation is based have proved inaccurate.

(*b*) attacks by insects or fungi, damage by fire or other causes necessitate special measures in the forest area concerned.

Jordan

• The Official Gazette of Jordan for 2 May 1953 publishes a law which gives the Ministry of Agriculture and the Forest Service the task of delimiting land on the territory of at least three villages in every province which shall be compulsorily planted with fruit trees on a third of the area and with forest species on the other two-thirds. Plants will be supplied at half-price by the Ministry of Agriculture, the other half of the cost to be reimbursed by the landowner in five annual instalments. Representatives of the Ministry of Agriculture and the Forest Service will give instruction in planting methods and care of the trees, and plantations will be put under the surveillance of village guards, one of whom is to be paid by the Ministry of Agriculture on a full-time basis.

Awards will be made each year to the most successful planters, but the law also provides for the application of a 1937 law for the protection of agricultural and forest lands in the case of losses suffered by planters, and for a severe penalty if the damage is proved to be due to the negligence of the owner.

Philippines

• A FAO Technical Assistance Officer writes that a factor contributing heavily to deforestation is the practice of kaiñgin (land clearing and temporary farming) on lands too steep for farming and soils not suitable for growing cultivated crops. This is an ingrained habit of many of the local farmers that cannot be stopped by prohibitory laws and police action where the local population in general is indifferent. The Bureau of Forestry is now conducting an intensive campaign of land classification to determine what lands under its control are suitable for farming and are releasing such lands for that purpose. In this way, some of the land hunger may be appeased legally. At the same time they are indicating the lands that should be retained permanently under forest and are increasing their efforts to remove and prosecute trespassers on such lands. The local forest officers are not sufficient in number or well enough equipped to cope with their problems adequately but they are doing what they can to educate local

regulations as to the importance of good forest practice and to bring it about gradually by regulations, persuasion, and prosecution.

At the present time, it appears that the forests are being cut faster than they are reproducing and the trend must be stopped as soon as possible if the country is to remain self-sufficient in forest products and have a surplus for export. It appears also that too much of the forest products sent to other countries is exported in the form of high grade logs. The Philippine national economy is thus losing the value of the jobs that would result from manufacturing these logs into finished products in the Philippines. Many factors beyond the field of forestry and forest products research are responsible for this situation but there is in it a challenge to forest products research.

Spain

• As a measure to control excessive planting of fastgrowing forest species on private land which could otherwise be given over to agriculture, the Government has decreed that in the provinces of Navarra, Guipuzcoa, Biscaya, Santander and Asturia an authorization must first be obtained before establishing plantations of *Pinus pinaster, P. insignis, Eucalyptus, Acacia* and poplar on private land. Requests to establish plantations of these species are examined by the provincial forestry and agricultural authorities and, in the event of disagreement, submitted to their respective ministries for a decision. Where a request is refused, the land must be put to cultivation according to the provisions of a law published in 1940. In irrigated areas where it is desired to encourage settlement, plantations of fast-growing species may be established on land not suited to agricultural purposes, or on an area not exceeding 5 percent of the total land area of any particular property, or as hedges and shelterbelts.

Union of Soviet Socialist Republics

• At its session in September 1953, the Central Committee of the Communist Party adopted certain resolutions for a large-scale increase, over the next two or three years, of supplies of materials, including timber, for light industry, the food industry and for the needs of the *Kolkhoz* (collective farms).

Several million hectares of forest have been given over to the collective farms for their permanent use. *Lesnoe Hozjaïstvo* reports that, although this area was estimated to be capable of producing 43.2 million cubic meters of wood by 1954, actual production in 1952 was only 6 million cubic meters because, while there is certainly overcutting on some collective farms, on others, notably in the east and in Siberia, many overmature stands are left untouched. Supervision of forest exploitation is therefore imperative.

Rational exploitation of "Category I" forests (those classified for protective, recreational and aesthetic purposes) would increase annual production, and at little cost. In January 1952, the extent of such forests amounted to 35.3 million hectares, with a potential 3,454 million cubic meters of timber, 50 percent composed of mature and over-mature timber. Since 1943 no major cut has been made in these forests, with consequent deterioration of the stands which no longer properly fulfil the protective role for which they were intended. In 1952, regulations were laid down for carrying out regeneration fellings. So far it would seem that cutting has been far too timid and, if it continues at the same rate, anything from 10 to 60 years will be required to clear the mature trees and secure regeneration of the forest. Here again supervision is needed.

Further improvements can also be made by:

1. increasing the quantity of cattle feed produced in State forests;
2. planting in State forests to increase the volume of possible annual cut, particularly of small wood which can be used by the collective farms;
3. establishment of protection plantations on the collective farms themselves which could after a decade or so, make an important contribution to timber supplies.

INTERNATIONAL UNION FOR THE PROTECTION OF NATURE

FAO was represented at the recent Copenhagen Congress of the International Union for the Protection of Nature, when a message of support from the Director-General was delivered.

Protection as interpreted by the Union, and utilization as understood by FAO, have both evolved and converged towards a broader meaning of conservation — the use of natural resources in such a way as to ensure their continuous and, where possible, improved usefulness to man.

Conservation is not just a sentimental desire and an idealistic notion. As said in a recent issue of American Forests, *published by the American Forestry Association, conservation is one of the biggest stories today. "Primarily, it is a scientific story of new discovery and it calls for good reporting by good reporters... Writers who really dig into the subject will quickly learn that they have come to grips with one of the most fascinating and many-faceted subjects on earth."*

For foresters, one facet is the establishment of national forest parks such as the Banff National Park in Canada, pictured in the illustration. Another is the preservation of representative tracts of virgin forest, where such still exist, for study and scientific observation. A plea that all countries should so preserve a portion of their heritage has recently been made by the President of the International Union of Forest Research Organizations.

Selected Reviews

FOREST PRODUCTS RESEARCH AND INDUSTRIES IN THE UNITED STATES. W. W. Varossieau. pp. 793. J. M. Meulenhoff. Amsterdam. 1954. Fl. 45.—.

This compendium of information on the wood industries of the United States is a fitting example of the kind of task at which the late Dr. Varossieau excelled: the compilation of multitudinous facts and information, and giving to others in an easily assimilable form the benefit of a wide knowledge gained in the most highly developed countries of the world. Dr. Varossieau's untimely death, while on leave from an FAO technical assistance assignment in Iran, robbed the Organization of a highly competent and useful officer.

Scientific and practical knowledge are strongly interwoven in the United States. The famous Forest Products Laboratory at Madison is largely involved in industrial projects of many different firms. The industry in its turn supports the Forest Products Laboratory and has set up a great many private regional laboratories. The book gives information on forest resources to show the background from which the wood industries arose and to explain their course of development. He describes work on the origin and structure, composition and physical and mechanical properties of wood — the knowledge which is instrumental in obtaining a maximum profit from the raw material and in developing new techniques in wood utilization.

The author says, typically, that he considered it " his obligation to make available ..... the information given him so freely in the United States. " The form in which he has done this represents a volume of permanent reference value.

FORESTRY. H.G. Champion, pp. 230. Oxford University Press. Home University Library of Modern Knowledge. 1954. Oxford. 6 shillings.

This excellent little book has not been written for those who are already familiar with the subject, but for the layman who wants to know more about forestry. It should be especially valuable for schools.

Professor Champion aims at presenting a comprehensive but simple survey of his subject, and a clear idea of the part forests and forestry play in the general picture of human activities and welfare. The whole subject is approached from the general point of view with the exception of the last chapter dealing with forestry in the United Kingdom.

The author thinks that in forestry perhaps undue stress has been placed on the importance of production of wood, and only delayed recognition has been given to the very vital role of forests in protecting soil and water supplies, in providing shelter to man and beasts and crops, and in holding up unstable hillsides or fixing sandhills liable to move with the wind and bury good land. The protective action of forest cover, which in no way reduces its productive value, is today receiving ever-increasing recognition so that " one may venture the prediction that the time will come when it will be considered the primary contribution of the forest to human welfare. "

THINNING PROBLEMS AND PRACTICES IN DENMARK. C. H. Möller, J. Abell, T. Jagd, and F. Juncker. pp. 92. Illus. World Forestry Series Publication No 1. College of Forestry at Syracuse, State University of New York. 1954. $0.80.

Dean H. Shirley and Professor S. O. Heiberg of the College of Forestry at Syracuse are to be congratulated on this first publication in their World Forestry Series. The expressed belief that the exchange of ideas and results will promote more fruitful discoveries by scientists echoes one of the basic principles of the FAO Forestry Division. As a means of furthering such exchange, therefore, this new World Forestry Series of publications is welcomed.

The articles on thinning which make up this publication will undoubtedly contribute to the thinking of foresters who are concerned with this phase of silviculture. The discussion of the influence of thinning on volume increment, as well as the description of various thinning methods, and the philosophy behind them, deserves attention. Even though the conditions which make it possible to use such intensive thinning methods in Denmark do not occur in many countries, the theories presented should prove stimulating.

It is interesting to note that even in Denmark with its 150 years of experience, there is not yet agreement on methods, frequency, or intensity of thinning. The summary of related investigations outside Denmark, where the range of soil and climatic conditions is greater, reveals even less agreement.

This publication thus suggests the need of so designing future thinning experiments as to permit valid comparisons of results. Modern principles of experimental design should help in this direction.

DIE ERNTE DES HOLZES (Harvesting of Wood). H. Gläser. pp. 150. Illus. Wirtschafts-und Forstverlag Euting KG. Neuwied/Rhein. 1954. DM. 6. 90.

The author, a forest administrator and, since 1945, a lecturer at the Forestry Faculty at Göttingen University, has produced a comprehensive and up-to-date study of work efficiency as applied to logging operations. This science, still in its infancy, has already been given application in other industrial fields, but has been slower in affecting forest operation where work must be decentralized and is therefore harder to organize. Organization is, nevertheless, indispensable since, for instance, modern selection cutting places a great responsibility on the loggers in the field, and makes good organization from the top essential in order that available manpower may be used to the greatest advantage.

The author discusses the basic principles of wood harvesting, the physiology of workers, logging equipment, and logging costs including wage scales and efficiency investigations. (See p. 165 of this issue). The result is a concise and readable text book for forest worker training centers, and will also prove useful for forest owners and administrators, and logging operators in countries of temperate climatic conditions.

FULL-TREE LOGGING. A. Koroleff. pp. 100. Pulp and Paper Research Institute of Canada. Montreal. 1954. Can. $ 3.50.

Full-tree skidding, moving felled trees complete with crowns from stump to landing, is a rather new development hardly known in most countries. It seems to offer a number of attractive possibilities for saving costs, wherever its application is feasible, such as possibilities for increased labor productivity, better supervision, full utilization of the tree harvest, slash disposal and better fire protection. However, little research has been carried out on it, so that knowledge about its practical feasibility is still quite rudimentary. In this preliminary study, Mr. Koroleff brings together all information on the subject available at the present time. It is, in his own words, a progress report.

Many features of full-tree logging appear to be of definite advantage especially in clear-out logging of virgin and uniform stands, such as in northern pulpwood operations. It has, for instance, already been reported from certain operations that skidding with full crowns (the branches acting as sliding medium and shock absorbers) has resulted in a decrease of damage as compared with log skidding.

It is to be hoped that this study may induce logging operators and research organizations to look more deeply into the matter of full-tree logging. The information which it contains will enable them to approach the method pragmatically, without losing much time on preliminary investigations.

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[1] Gen. = *General*
Sc. = *Fundamental Science*
Silv. = *Silviculture*
Log. = *Logging and Engineering*
Prot. = *Forest Injuries and Protection*
Mens. = *Mensuration and Surveying*
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Israel	Conservator of Forests, Department of Forests, P.O. Box 88, Ilanoth, Nathanya.
Italy	Direttore Generale dell'Economia Montana e delle Foreste, Ministero Agricoltura e Foreste, Roma.
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Jordan	Director, Department of Forests, P.O. Box 603, Amman.
Korea	Director, Bureau of Forestry, Ministry of Agriculture and Forestry, Seoul.
Laos	Directeur des Eaux et Forêts, Ministère de l'Economie Nationale, Vientiane.
Lebanon	Directeur des Forêts, Direction des Forêts, Ministère de l'Agriculture, Beyrouth.
Liberia	Department of Agriculture and Commerce, Monrovia.
Libya	Ministry of Agriculture, Tripoli.
Luxembourg	Directeur des Forêts, 8 rue du St. Esprit, Luxembourg.
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Nepal	Director, Department of Agriculture, Government of Nepal, Katmandu.
Netherlands	Director, State Forest Service, Museumlaan 2, Utrecht.
New Zealand	Director of Forestry, New Zealand Forest Service, Government Buildings, C.P.O. Box 894, Wellington C. 1.
Nicaragua	Jefe del Departamento Forestal, Ministerio de Agricultura, Managua.
Norway	Direktoratet for Skogbruk, Landsbruksdepartementet, Oslo.
Pakistan	Inspector-General of Forests, Agriculture Division, Ministry of Food and Agriculture, Government of Pakistan, Karachi.
Panama	Jefe de la Sección de Tierras, Bosques e Ingeniería, Ministerio de Hacienda y Tesoro, Panamá.
Paraguay	Jefe del Departamento Forestal, Ministerio de Agricultura, Asunción.
Peru	Jefe de la División Forestal, Ministerio de Agricultura, Lima.
Philippines	Director, Bureau of Forestry, Department of Agriculture and Natural Resources, Manila.
Portugal	Direcção Geral dos Serviços Florestais e Agrícolas, Rua das Amoreiras 124, Lisboa.
Saudi Arabia	Ministry of Agriculture, Jeddah.
Spain	Director General de Montes, Caza y Pesca Fluvial, Ministerio de Agricultura, Madrid.
Sweden	Deputy Chief Skogstyrelse, Stockholm.
Switzerland	Inspection Fédéral des Forêts, Chasse et Pêches, Berne 23.
Syria	Directeur des Forêts, Ministère de l'Agriculture, Damas.
Thailand	Director-General, Royal Forest Department, Bangkok.
Turkey	Director of Forestry, Ministry of Agriculture, Ankara.
Union of South Africa	Director, Department of Forestry, Plaza Buildings, Pretoria.
United Kingdom	Director-General of Forestry, Forestry Commission, 25 Savile Row, London W. 1.
United Kingdom Territories	Forestry Adviser to the Secretary of State for the Colonies, Whitehall, London S. W. 1.
United States of America	Chief, Forest Service, U.S. Department of Agriculture, Washington 25, D.C.
Uruguay	Jefe de la Sección Forestal, Ministerio de Ganadería y Agricultura, Montevideo.
Venezuela	Director Forestal, Ministerio de Ganadería y Agricultura, Caracas.
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